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IN ALL THEIR DEPARTMENTS.

BY A COMMITTEE OF PRACTICAL SURVEYORS, ENGINEERS, AND ARCHITECTS, OF MUCH EXPERIENCE AND IN ACTIVE EMPLOYMENT.

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AGRICULTURAL ENGINEERING.

TITHES, AND THEIR INFLUENCE.

We have, upon several occasions, pointed out the necessity of calling in the civil engineer to assist in those more extensive improvements of the soil, for which neither the proprietor nor the farmer is, generally speaking, competent, and which he could not carry rightly into effect though he were, without distracting his attention from his other avocations. In our preceding number, we incidentally mentioned wheat, as an instance of the advantage that might result from a general and systematic improvement. We took our data from those who appear to have the best information on the subject, and the result is entirely borne out by our own observation as far as it goes. We stated one quarter per acre, or 4,000,000 quarters from the present breadth of wheat land, at least £10,000,000, as a very reasonable expectation; but upon re-considering the subject, we think that it would be one and a half times this, or probably twice as much, or 8,000,000 quarters addition annually. This would not only supply the home demand, but would change England from an importing to an exporting country, as was formerly the case. The data upon which we ground this conclusion, are comparisons of the most and least productive land with each other, and of each of them again with the average. Taking this average at the present produce, increased by the 8,000,000 quarters, we find that there is a far greater breadth of land now producing less than this average than there is producing more. Then, from our own observation it appears, that in climate and natural circumstances, some of the lands which produce the smallest quantity are equal to those that produce the greatest. We have observed two farms lying in juxta-position, with the same geological soil, the same exposure, the same natural drainage, and every thing the same but the artificial improvements, and yet the one farm yielded twelve or fifteen per cent. per acre more than the other: nor was the cause of this difference at all obscure; for the cultivator of the lands yielding the smaller return, was an ignorant man and slovenly farmer; his lands were not improved, manured, and worked as they ought to have been. He had neither skill nor capital of his own for effecting those improvements. and even though he had had, he met with no encouragement from his landlord, but quite the reverse: ejectment from the farm hung over him like a lash, and would certainly have been laid on had he put the land in a better condition. He who obtained the larger return, was a man of property, a most skilful farmer, and perfectly secure in his occupation.

The same difference reigns through all the departments of the two farms, whatever might be their produce. The skilful farmer had heavy crops of hay from his artificial grasses, while those of the other yielded an insignificant quantity, and that not good. The grasses of the first were long, close, and succulent, and played in the summer breezes like a tree of nobler height; those of the other were like small copper wires, among which the winds whistled, as on a naked hill-side, without producing any wave. The turnips of the one covered the ground, and were gay and well-flavoured; those of the other were in little shots, here and there one in the naked field, and the few that were of them were small in size, and almost as hard as brickbats. Of course both the working stock and the marketable corresponded.

It is in the very nature of farming, for the improvement of the land to any one purpose, to extend the benefit to all other purposes; so that an improvement of the wheat land and an increase of the quantity of wheat, will, as rotation extends it over the farm, increase all sorts of produce, whether vegetable or animal; and the very same process which gives us more wheaten breat will also give us more beef and mutton; and all will be improved in quality as well as increased in quantity.

But in order to obtain those benefits upon what may be called the great or national scale, the engineer must precede the cultivator otherwise much of the labour and expense of the latter will be in vain. It is a fact, however, and a fact much to be regretted, that the engineer has not hitherto been systematically called in; and that agricultural engineering has no reality, or even name, as a science. The land is thus very much in the same state at present, as stock was before the systematic study and practice of veterinary surgeons. Pretenders to drainage, and other individual operations, spring up now and then, as cow-leeches did in former times; but like these, not a few of them are quacks. Then, again, though there are professors of agriculture, and agricultural societies, these pay no attention to the grand subject of improving the land. If upon any occasion the professor turns practical farmer, he is generally the worst in the district; and if he persist in being a practical man for any great length of time, he is sure to ruin himself, however profound and plausible he may seem in his lectures. The societies again show implements, the greater part of which are quite useless, and stock which no grazier could afford to raise, and which are not the very best for the market though he could raise them. For some selected specimens of both of these, prizes are awarded; the members dine copiously and harmoniously, make many speeches, and drink much wine; and then ride away to their homes, exulting in the hearty lift they have given to the art of cultivation in all its departments. In this exultation we believe they are sincere; yet that only makes the case worse; because it shows that there is ignorance in the highest departments of this, the most valuable occupation in the country: therefore we desiderate the introduction of the engineer.

But here there arises a previous question:—Are there any obstacles which lie in the way of the engineer? And if there are such obstacles, are there any means of removing them? The first branch of this question we must answer in the affirmative, and we trust we may be allowed to do the same with the second.

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Tithes, as they have long been collected in England, are among the obstacles which oppose the calling in of the engineer to improve the land. With the fact of tithes themselves, as a permanent provision for the clergy of a national church, we have no wish to find fault: on the contrary, we think the Establishment, and the provision for its support, are both highly necessary, and might be made greatly useful. The appointment of one gentleman of first-rate education and polished manners to every parish, is, independently of all spiritual considerations, a great temporal blessing. In order, however, that this blessing may be full and complete, and all parties enjoy the good which it involves, it is absolutely necessary that every clergyman of the Establishment should live constantly in his parish, inform himself of the characters and conditions of all his flock, and be their friend and counsellor in temporal matters, as well as their instructor in spiritual ones. It is not even desirable that any one living should be collegiate, although the incumbents are a rector and a vicar, or even though they were both rectors or both vicars. If the population require it, and the living is adequate, such a parish should be divided into two, so that there may be one minister and one people, in every local establishment. The system of curates is a most pernicious one, and has done more to make the English populace dislike, and even despise, the national church, than all other circumstances taken together. As long as the duty is done by one man, whose pittance barely keeps him alive, and the tithes, the express and only object of which is the support of the officiating clergyman, are levied and spent by another man, who fares sumptuously every day, mingles in fashionable society, and probably does no clerical duties at all; so long must the church be looked upon as a excrescence and burden, whatever it may be in principle, and, in other instances, in fact.

These remarks may, at first sight, seem irrevelant in a paper, the main object of which is to show how tithes are an obstacle to calling in the engineer for the improvement of land, so as to make it more fit for the operations of the farmer and the grazier. Closer examination will show, however, that there is a very intimate connection between them, because the system produces a sort of repulsion between the church and the people, which designing men can easily augment to separation. The poor curate is a man to whom nobody will look up, because the only recommendation he can have is his private virtues, and these have no place among the attributes which attach the multitude. The only man who could make the church respectable and beloved lives at a distance from his parish, gives himself little trouble about it, or if he does spare an occasional visit, he recognizes only the higher ranks, and entirely overlooks the great body of the people; and, though it may be unjust, it is quite natural for them to construe this simple overlooking into intentional despising.

What are consequences? Why, the unthinking and the unstable in mind among the people dissent from the national church, and seek for their spiritual instructors, parties who are every way inferior to proper clergymen. There are exceptions now and then, and often splendid ones; but in general it will be found that these dissenting holders-forth are very inferior men. They are badly educated, or if they have knowledge, it is so mixed up with prejudice that it is more dangerous than useful: very many of them are tradesmen or labourers, who have been proved to want both talent and industry for their original callings; one and all of them are greedy sturdy beggars in their pious matters, as one would say, and not a few are gross, sensual, and voluptuous in their private habits. Thus, when they appear in public they affect saintship, while in reality they are time-serving hypocrites, and as they stand upon no ancient and honourable foundation, do not, like the clergymen of the Church, belong to an establishment which they must not disgrace; each is for himself, like a mercantile speculator of very low grade. Hence, they have nothing to recommend them to a congregation, or enable them to keep that congregation together, save their own personal appeals, and experience shows that the loudest and most incomprehensible ranters succeed the best, and are the greatest favourites.

We say again, that this may seem to be a mere episode, foreign to the main object announced in the title; but as we are about to advocate, in a few sentences, the propriety of a national provision for the Established Church, which no rulers of the time have any title to take away, we thought it right to point lightly at what the clergyman ought to do in return for his tithes; and to show the consequences of his failing to do this rightly, as well as how these consequences recoil upon the church, and alienate from it a very considerable portion of the people.

The great and leading objection which is raised by many to the provisions for the national church, whether in supporting the clergyman, or in keeping the building in repair, and rebuilding it when necessary, is the want of title to the provisions so made. This is a question upon which we are at issue with the objecting parties; and if we can show that the clergyman has a good title to his tithes, it will follow as matter of course that he has an equally good title to demand the price of repairing, keeping in order, and, where necessary, rebuilding the church, whether the parties on whom the demand is made attend divine service in the church, or not. Without a fit and proper building, the clergyman cannot perform his public duty; and, unless the church is in decent order, the people cannot attend it comfortably, or even, in some states of the weather, without endangering their healths; and it is a matter of notoriety, that, in various country places, where churches are damp and shattered, and are, in fact, little better than pig-styes, more colds are caught in them than in any other apartments whatsoever.

The question of right, is, however, the main one with which we have to deal; and here we assert, and dare contradiction, that the right of the clergyman to his tithes, and of the church to its temporalities, whatever these may be, is as good as any right to property in the country. Let us go to the beginning, and ask what right the present inhabitants of England have to the country which they possess? They are Normans, Saxons, Belgæ, Britons, and it may be many other races that are lost to history, or, rather, that came before the earliest historic record. There are traces of the advances of the Belgæ in the southern counties, in long breast-works, and a sort of redoubts; but chiefly in breast-works. Of these, the ditches and steep escarpments, in so far as they can now be traced, are invariably turned to the interior of the country, which shows that the Belgæ, landing on the coast, had pushed by conquest as far as the great forest, which extended from Rye westward. Another thing is worthy of notice: the burrows, which contain the remains of the slain in those early wars, are always on the British side of the Belgic lines, and hence we are led to conclude, that, in these battles, the Belgæ were both the aggressors and the victors.

But did this mode of taking possession give the Belgæ a right to the land of England, in any sense of the term recognized now? Certainly not; for every man who knows right from wrong, must

condemn this mode of taking possession, whatever good the Belgæ might have done the country afterwards. The possession taken by the Romans was also a forcible possession; and thus, though the Romans probably did more good than counterbalanced the evil of their wars, that did not give them a right to their country in the sense in which the word is now used. The Saxons came in as merciless plunderers of the very worst description; they undid much, if not all the good which had been done by the Romans; and surely such was very questionable ground upon which to found a right. The Normans close the list; and, though the last of the Saxon monarchs granted the crown to William, that gave William's followers no right to the lands of the Saxon thanes. The Normans are entitled to more of our gratitude than any of those who preceded them; and if Tyrrel had not been hired by a foreign power to assassinate Rufus, they would have done far more; but even this did not give them a right to the country.

The population is substantially made up of these races; and though many foreigners have settled in it since, not one foreign nation has come in sufficient strength, and such possession has never been attempted. We owe this to, perhaps, the very worst of all the conquering races, and the one whose kings were, generally speaking, the most profligate. But, even in the dark sky of Saxon domination, one star shone out with transcendent lustre. That was king Alfred, justly termed "the Great," though there was no other monarch of the name to contrast with him. He established the British navy, and while that keeps the sea, and justice is done to it, England will remain Invincible.

Such are the grounds upon which the inhabitants of England hold their country; for they are those upon which they originally obtained possession of it, and we dare any man to say that the grounds upon which the clergy are entitled to their tithes can have less of right in them than these.

When Henry VIII. took forcible possession of the monasteries, nunneries, and other religious establishments, and their lands and properties, whether they belonged to the Church, in our understanding, or not, had he any right to this? or was it not rather lawless and tyrannical plunder? It avails nothing to say, that those monastic institutions were Popish; for Henry arrogated to himself the title and office of Pope in England, and used his usurped character and authority for the very worst of all secular purposes. Very many of his favourites were enriched out of the plunder; and not a few of their descendants still hold the land and enjoy the other advantages. Now, have these parties a right to possessions thus acquired at all comparable to the right which the clergy have to their tithes? In order to obtain these, they robbed nobody; for, on the contrary, the tithes were granted by men out of their own property, and approved of and confirmed by law. Indeed, the more we consider the question, the more are we convinced that the right of the clergy to tithes is one of the clearest and most legitimate rights in the country. The very uncertain nature of the rights to other property has rendered it necessary that there should be a prescriptive limit, beyond which possession cannot be disturbed, except upon the clearest and best authenticated documentary evidence. In the case of lands and other real property, we believe that fifty years is the term in England, but the right of the clergy to their tithes rests upon more than ten times the length of possession; and, though it does not descend to corporeal heirs, it does to official successors, which amounts to the same thing, and even more, for no dying out can alienate the tithes of a parish. Generally speaking, the tithes being chargeable on the land—for without land, there would be no titheable produce—partake of the permanence of a landed estate, and they have this advantage, that, whatever may be the conduct of the incumbent, the living cannot be forfeited so as to revert to the crown. The incumbent may be ejected, but the living is just as secure to his successors as though he had died in peaceable possession of it.

Such is the right of the clergy to their tithes,—unquestionable, and unalienable, from the church, though not from the individual incumbent; and we have just hinted at the moral duties which are binding upon the clergyman in return; and these, whatever may be the state of the country and the people at all times; but there is another obligation upon the clergymen, or the managers of tithes, whoever these may be, to which we call attention: the clergyman has his right, which neither can nor should be taken away from him; but, on the principle of reciprocity, he should do no wrong intentionally, or even unintentionally, to anybody else. Now, we think that the peculiar mode of exacting tithes does a great deal of harm to the agricultural interest, and, through that interest, to the nation generally, though we are quite certain that nothing can be farther from the intention of every churchman.

Without any allusion to the vexation arising from the exacting of tithes in kind, which breeds so much animosity between clergymen and their parishoners, and leaving out of view the monstrous absurdity of lay impropriators holding tithes—which is nothing but sacrilege, cloaked over by the mantle of law; notwithstanding these, there is now, and has been from time immemorial, a vicious part of the tithe law, which has lessened the productiveness, as well as the produce of the country. To what extent the Commutation Act may remedy this, or whether to any extent at all, is a point which we shall not now examine. An Act of Parliament which has not been in operation for a considerable time, is a bad foundation upon which to ground an argument; and even Parliament themselves are obliged to try it at a venture, and then patch and amend it before it will work at all, just as a she bear in northern climates is said to lick her cubs into shape, otherwise they would never get the use of their limbs.

The grand objection to the details of the tithe law—for to the principle of tithe itself there is none—is, that it is keeping, and has kept, no small breadth of land out of cultivation, and tended to deteriorate that which is cultivated. It is true that it is not wholly to blame, at least for the first of these consequences; for the common law comes in with its "customs, particular customs, and certain particular customs," as its own brief and clear vocabulary has it, and acts its part in the mischief. This mischievous portion of the common law acts through the medium of commons, of lands which are no man's property, but which, in their use, such use as it is, are common to the parish, the hamlet, or other locality, whatever may be its name. These often consist of the very best land in the neighbourhood; and that land is turned to the very worst of purposes. It becomes a rendezvous for blackguards of all descriptions; and, in remote parts of the country, squatters take possession and build hovels; and thus loose characters are distributed all over the land, as if by express intention. In the neighbourhood of cities and towns, open ground is necessary for recreation and health, but in country places such ground is not necessary. As an example near London, take the heath or common between Putney and Morslake: that has a fine climate, there is every

facility for improving the soil, and a certain market at no great distance; the adjoining lands let at high rents, and yet the cultivators make comfortable incomes. But, while all this is doing around it, Putney heath is worth very little. Some score of geese, a few starving cows, and one or two blind or lame horses are turned out upon it, but that is next to nothing. In England, there are many thousands of acres of such commons, say one hundred and sixty thousand, and these, independently of all other crops, which would go far in paying the rent and the current management, might yield two quarters of wheat per acre every fourth year. This would be at the rate of 80,000 quarters a year, which would be upwards of £190,000.

For the annual loss of this large sum, the mode of laying on the tithes is not to blame in the first instance; but, unless a wonderful change is effected by the Commutation Act, the tithes are to blame even here, because, if these lands were once brought under crop, the clergyman, or lay impropriator, would come in for his tenth of the produce, which would be equal to many times the profit for years after the improvement; the improver would thus not only be working solely for the owner of the tithes, but paying for leave to do so, which would be an unseemly state of things.

It is in this way that tithes have operated in keeping out of cultivation large patches of the best land in England; and it is not too much to say, that there is as much land in Middlesex, lying waste in green lanes, corners, and hedge sides, as would support all the poor of the country parishes. In other counties, especially the midland counties, and pretty generally throughout all the richer parts of England and south of Yorkshire, the state of things is the same. With the exception of the larger manufacturing towns, the waste land,—not the moors, and in exposed and naked soils,—but the very best soils in the localities, would support the poor; and, therefore, though tithes are established upon a right which is unquestionable, and though no blame whatever attaches to the clergy, the mode of laying on the tithes is the parent of the poor-rates.

In many parts of England, the arable lands are divided into small paddocks with crooked outlines, and separated from each other by unseemly hedges, which occupy the summits of large mounds of accumulated soil; and, if such a casualty were to happen as that England should be depopulated, deserted, and allowed to run to waste for a century or two, and then a new people to come and take possession, they would take those paddocks with mounds for redoubts, and conclude that the former inhabitants had been in a state of constant hostility all over the country.

There is another evil in the mode of exacting tithes, which operates strongly against the improvement of such lands as are under culture. If the cultivator goes to the expense of improvement, and all proper improvements of land are costly, the owner of the tithes comes in for his tenth of the additional produce. Is this right, and is this additional levy part of the legal tithe, or is it an unjust exaction? We answer, it is not right, and the tenth of this additional produce is not part of the legal tithe, but a most unjust and mischievous exaction. The legal tithe is on the land, and the land only; and the tithe-owner has no right to a tenth of the skill and diligence of the improver, or of the substances purchased for effecting the improvement. At the time when tithes were first granted to the clergy, these things could not have been contemplated; and of course no right to them could have been conveyed. One of the most efficient substances for improving land so as to obtain the greatest possible produce from the same breadth is bone dust; but no man in his senses would say that the tithe of bone dust was given to the clergy; and it is obvious that the tithe of what bone dust produces, is much the same as that of bone dust itself. There are other causes why English farmers do not, even where they can afford it, go to the expense of so improving their farms as to turn them to the greatest advantage; but what we have now stated is unquestionably one such cause, and a very powerful one.

Another evil, and the last which we shall enumerate, is the actual impoverishment of the land, resulting from the mode of laying on tithes. We already mentioned that, in many of the richer parts of the country, the land is cut up into small paddocks, separated from each other by hedges on great mounds of earth. Now, these shapeless little patches are ploughed at nearly double the expense of large square fields, where an army of swing ploughs, each managed by one skilful ploughman, can slice away, with long furrows as straight as a line, and few turnings at the head ridges. Then there are many of the irregular nooks which cannot be ploughed at all, nor can the ploughing be brought close to the crooked hedges. Therefore, the labouring of one of these patchwork farms is far more costly than that of a farm properly laid out; and, after all, a considerable fraction of it remains uncultivated, and serves no other purpose than harbouring vermin and innumerable birds, which, however pleasing they may be to a naturalist, are sad pests to the farmer.

Then the mounds, upon which the rugged and unseemly hedges stand, are perfect robbers. They seize and retain that richer part of the soil which is blown by the winds, and for this abundant nourishment, they return to the paddock the seeds of rank and destructive weeds, while weeds which do not thrive on rich soils, spring up abundantly in these starved and hungry patches.

If there were no obstacle in the way, these unshapely paddocks might be turned into well-formed and commodious fields: this would not only give a greater breadth of land than is under the plough at present, but it would assist in putting that land into better condition. We have said, that the mounds upon which the hedges stand, are composed of the richest soil of the adjoining grounds; and, if this soil were chopped up, and formed into a compost, with manure, lime, and other substances, such as the case might require, it would suffice for putting the newly-formed fields into excellent condition; and then, by a proper rotation of crops, they would remain in condition for a considerable time, as long, at least, as till the stables, the farm-yard, stall-feeding and green crop soiling, would supply a second dressing for a great part of the breadth. After this, by skilful management, its own produce might keep the farm in heart, and the return, both for the corn merchant and the butcher, would be greatly increased. The increase, indeed, would be far greater than the average of one quarter of wheat for every acre under that crop, which we have formerly stated, as the reader may find by looking back to an article on the Agriculture of Cheshire, beginning at page 214 of our October number. In answer to one of the queries there put, it is stated that the ordinary return among the slovenly farmers of Cheshire, who appear to form the great majority, the produce in wheat is about eighteen or twenty bushels an acre; but that, among the best farmers, who manage their land properly, the produce is, on an average, from thirty-five to forty bushels an acre. This is a very striking case; and there is no reason to doubt the truth of it, because there are similar instances in almost all the agricultural counties. One good

farm to twenty bad ones, leaving out small portions here and there, which are all well cultivated, may be about the average state of England, though, individually, the good farmers rent or cultivate the greatest breadth of land. Upon these data, it is not an exaggeration to estimate the increased produce of the four millions of acres at eight bushels per acre, or four millions of quarters upon the whole: this is more than could be imported from all the countries in the world; and it could be obtained not only at no more cost than the present comparatively small quantity, but absolutely at less. Superior implements, and better workmen, especially ploughmen, would save a great deal in horse power; and lands in good condition are always more easily worked than lands which are poor, or filled with couch and other roots which retard the motion of the plough. The substitution of the swing plough for the clumsy wheeled instrument still in use in many parts of England, would, upon most soils, be a very great improvement. We were astonished to find, in the agricultural counties of the south of England, wheeled ploughs, with two men, or a man and lad attending them, upon soils where one good plough-man, with a swing plough and pair of horses, would have turned up more of the soil, and done it far better. Upon asking the reason of this slovenly way of going to work, the answer which we uniformly met with was, that the wheel-plough could be set to the depth of furrow wanted, and thus every labourer could be a ploughman; but that, if they used the swing plough, they would be obliged to employ skilful ploughmen, which would cost them more in wages. We pointed out the evil in the wheel ploughs of turning up the dry "hursts" to the same depth as the richer parts of the field, and thus spotting it over with barren patches, whereas, with a swing plough, the ploughman could regulate the depth of his furrows so as to have the most productive portion always at the surface; but the invariable objection was, the higher wages that must be paid to better ploughmen.

We do not say that even the principle upon which tithes used to be, if they are not still, levied in England, are yet chargeable with any of these last-mentioned evils; but it is directly chargeable with the first, that is, with bringing under the plough the patches of waste, with which even the most fertile lands are interspersed. Indirectly, too, it is chargeable with a part, at least, of the other evils; for, when tithe is exacted in the ratio of the produce from year to year, it cannot but tend to weaken the desire of increasing that produce.

We have admitted, that the right of the clergy to tithes is equal to any right in the country, and better than most; but that they are entitled to the tithe of all agricultural improvements, is a far more questionable matter. The proper meaning of the tithe is, to have secured upon the land, or other real property which cannot be carried out of the locality, an adequate living for the clergyman, care being taken that the collecting of this living shall not stand in the way of any improvement.

It appears, that the only way of doing this is to value and commute the tithes, and make them a rent charge, payable by the landlord, and not by the tenant, as thus the latter would be left perfectly free to make improvements. Then, the tithes upon any one farmer should have nothing to do with an increased produce of that farm. They should be charged in gross upon the whole manor or estate; and there should be no increase without cause clearly shown. In a country rapidly improving, clergymen of course require additions to their livings, at least in many places, because it is necessary that the clergyman should make a respectable appearance, as, without that, his people will not look upon him in that light which will give proper effect to his ministration. This, however, should be done upon each case for itself; and there should be a court, not an ecclesiastical one, established for deciding in these cases, and it should be easily accessible, and its judgments final. After granting one increase of this kind, some definite number of years ought to elapse before another could be granted, unless upon a petition from the clergyman, the proprietors, and the leading portion of the parishioners jointly. They are the parties best able to judge in such a matter; and if they come forward amicably together with any petition to the court, the prayer of that petition ought to be granted.

We have now, we believe, touched upon all the points in which the mode of collecting tithes is injurious to the agricultural interests, by discouraging improvement, and preventing the calling in of the agricultural engineer to point out those more extensive improvements, which cannot be expected from the farmer. We trust we have done this, without even a shadow of hostility to the Church; for we have endeavoured to demonstrate the unquestionable and unalienated right of incumbent and registered clergymen to their tithes; and we have endeavoured to show, that those evils of the system which are injurious to agriculture, are in no way owing to the clergy.

But the subject is one of the greatest importance, and, therefore, other branches of it, that is, obstacles occasioned by other indifferent causes, will have to be noticed from time to time. The importance of the question appears in a striking light from what is said of the good and bad farmers of Cheshire, and the general inference which we have deduced from that. The increased produce on the wheat land of two quarters per acre, might be rated at five pounds increase of value on the wheat crops, independently of the superior quality of the straw. A dressing with bone manure costs about four pounds an acre; and thus, if the farm were dressed for the wheat crop only, one pound would be gained per acre in the first year; and the dressing would give often three excellent crops, and not be quite exhausted after all. By such a system of management, a farmer could afford to pay £1 an acre more for his land than he does at present; and, with such an addition to rent, the tithe, as a rent charge upon the proprietor, would not be felt.

SURVEYING A CITY OR TOWN.

In surveying a great city, such as London, or even a plane occupying far less surface, and not having the streets so numerous, narrow, and confused;—in doing this with a view to the obtaining of a perfectly accurate plan, for the purpose either of inspection or of projecting new streets, the common practice which is resorted to in the field surveys of estates will not answer. This is especially the case with old cities and towns which have been built without any regular plan, and consequently whose streets are of an endless variety of lengths, meet each other at all angles, some straight and some crooked, and the latter not forming regular curves of any order. Such surveys are often attempted by the chain and compass; but as there are no points of verification, this method cannot be accurate, and without such points, even the theodolite,

though greatly superior to the compass, cannot be depended upon.

These, we believe, have been the principal instruments made use of in surveys of London, and the consequence is, that, in the crowded parts of the city especially, none of these is correct; and if there has been a survey for each of any one, they are never like each other. Of the common maps that are sold as guides to strangers, or for other ordinary purposes, there is indeed no substantial difference. If it is to be on the same scale, the former map is rubbed down; the new streets, or other alterations, are put in not more accurately than the old part of the work, and the suburbal additions are inserted, still without any thing like a regular survey. If the scale is to be larger or smaller, the map, so rubbed down, is enlarged or reduced in a corresponding manner; it is then engraved on the plate, worked off at press, and forth it comes to the public, a new map from an original survey; and is advertised and puffed accordingly. One fault that runs through the whole of these maps, is, the extraordinary width which is given to the streets, which is, in many instances, ten times greater than the true proportion. This serves one purpose, however: by means of it the names of streets can be written in legible characters, in cases which, if the true proportion were observed, no names whatever could be inserted. Thus, though such maps are rarely inaccurate, they suit better for those who merely wish to find out places, than if they were better maps: but still there are other and more important purposes, for which they do not answer nearly as well, as they cannot be made the basis of decent calculation; and, therefore, besides these rough sketches, there ought to be a map of the British Metropolis, as accurate as it can be made, though absolute accuracy is quite impossible, in such a Babel of streets and buildings.

The proper method is, to get triangles joining all the conspicuous points; and these will form the ground-work, to which the details can be adapted. Great accuracy is required in taking the angles of these triangles; and there are some cases in which a point of view cannot be made exactly a point of observation, and in such a case the angle must be reduced to what it would be at the very point of view. In general, however, these excentricities are so small that the connection cannot be made; and in no case of city surveying is it necessary to attempt calculating the spherical excess. The first thing to be done is, to obtain a base, or more than one if necessary; and the distance of those bases at their proximate extremities, and the angles which they make with each other, should also be ascertained.

We shall take London for our example, because in it we have several bases, all meeting each other, and also all as nearly horizontal as is necessary in such a case. These are the crowns of the bridges, the distances of which, if not already known, are easily measured; and so are the angles which they make with each other where they meet. For a central survey, Westminster bridge, the intermediate ones, and London bridge give four bases, from which a certain number of points on both sides of the river can be accurately determined; and the scale of the map being determined on, these bases are to be plotted down as the first part of the ground-work in its first stage.

A field book is then to be prepared, each division of it divided into two columns by a line, and the name of the bridge written at top of that line. The words "left" and "right," are to be written at the tops of the two divisions of the column answering to the left and right hands of the observer. The names of the points to be ascertained, which are those where spires and other conspicuous objects are situated, and which are also visible from the next bridge, are to be written in order from left to right, and a column made outside each of them in which to mark the measures of the angles. These are to be taken by a good theodolite, firmly placed and levelled; and this being set to zero, and turned until the object, that is, the flag or mark on the next bridge, is opposite the cross wires in the telescope, and then the under plate is to be firmly clamped; from this, move the upper plate and telescope until the cross wires are in the centre of the last object to the right, the degrees, &c., being read off, are marked opposite the name. Shift, read off, and mark for all the objects in succession, and continue marking in the right-hand column, until you come to the nearest one to 90°, or a right angle. Go on in the same direction, but work in the left-hand column until you come to the last object, which ought not to amount to nearly 180°, with the original line to the next bridge. This being done, unclamp the under plate, adjust the instrument to zero, and turn both plates till the cross wires intersect the last object; then clamp the under plate, and move the upper one and telescope until you come to each of the objects in succession, from left to right, and if they agree with the former readings, and the whole of the angles brings the instrument exactly back to the mark or flag on the next bridge, you may conclude that the angles are correct.

If so, lift the instrument, put a staff and flag exactly in the centre where it stood; convey it to the next bridge, and place the centre of it exactly over the point there where the flag was placed. It is necessary to have two assistants, one to take each flag; and when you complete your observations on the second bridge, the flag-man on the first is to place his flag exactly on the centre of where the theodolite stood on the second, when the flag-man on the second carries his flag to the third, and places it there.

In taking the angles at the second bridge, turn first to zero, turn the instrument to the flag on the first bridge, clamp the plate, and measure and read the angles from your right to your left, the names of the points which were right-hand column in the former observation being left-hand here: they must not extend beyond 45°. The remaining places are to be marked in the right-hand column, and the measuring continued until the cross wires intersect the flag on the third bridge. All the angles are to be read and marked; but if there are any which are very acute with the line to the flag on the third bridge, places need not be worked on these except for inspection. On this being done, the instrument is to be adjusted to zero, and clamped, turned round until the intersection of the wires is on the flag on the third bridge, and then the angles are to be taken and read off again from right to your left; and if they and the sum of them agree with the former readings, you may conclude that they are right; proceed in the same manner, taking the angles of each object at two bridges, but not at any until you arrive at the last one. If the plan or map is to be continued, take right-hand angles to the objects below it, but you must not make the sum of them and the left-hand angles amount to too nearly 180°; the angles marked left at the first bridge, and those marked right at the last, determine the points only in one direction, and one for continuing the plan upwards and downwards by additional bases.

In all the intermediate parts of your field-book, you will find each point marked right-hand at one bridge, and left at the next

below; and from all these you have the data for plotting the points in a correct manner.

For obtaining each you have only to draw a line at the proper angle on the one hand, and another at the proper angle on the other hand: the crossing or intersection of these lines is the true place of the point. If you wish to triangulate for points on the Surrey side of the river also, you may either take them along the others and mark them in the opposite order in the field-book, or you may return back again and take them in a separate series, which is perhaps the better way. When these points are all plotted, they give you a new system of bases, from which a new set of points can be determined in the same manner; and from these, again, another system may be extended, until the position of all the most conspicuous objects on the left or London bank, and the right or Southwark bank, are determined. If there are single objects in the suburbs, or even beyond them, which you wish to include in the map, the angles which lines from these make with the two ends of a line already known, will determine the position; only you must take care that the distance of the object is not too great as compared with the base from the points of which the angles are taken.

If the steeples, towers, or other conspicuous objects which are plotted from this first triangulation can be ascertained, and are high enough for commanding views of important points not visible from the bridges, a second triangulation may be made; after that a third, until as many points are determined as may be thought necessary. These points should be marked with dots in Indian ink numbered in pencil, and the numbers with the names attached entered in a list for future reference. After this, the lines of triangulation had better be rubbed out, as they are apt to breed confusion in plotting the details. These details are then to be obtained as accurately as possible, by chaining for the lengths, using the compass for the angles, and the measuring tape and staff for short distances; and wherever that is practicable, the theodolite should be used, especially at centres or crossings, from which long and straight streets extend in various directions. Those details should be taken with the greatest possible care, because, in a city or town, lines of verification can seldom be obtained; but the points determined by the triangulation answer as a sort of substitutes. The finding of these details is a matter of very great labour, and for a large city it ought not to be attempted at once, but done in sections, and each section plotted before the next is surveyed. Every section should include some of the points determined by triangulation, which points should also be determined by the survey for the details. If, in plotting the details, the points found in surveying for these fall exactly upon the same points as found by triangulation, the survey for the details will be correct; but if they fall at a considerable distance, the survey is inaccurate; and as there are no means of knowing in what part of it the error lies, the whole must be gone over again, and gone over repeatedly until it coincides with the triangulation.

It must, however, be borne in mind, that the triangulation, or rather the meridian line of the triangulation, shows the true north and south, while the angles of detail taken by the compass have the magnetic meridian. They must, therefore, be corrected for variation; and if the compass is a good one, and the situation such as not to deflect the needle, the best way of making this adjustment is the following: Draw across the true meridian on the paper, a magnetic meridian, making the proper angle of variation with it; and, with an accurate parallel ruler, draw lines across the section to be plotted, all parallel to this magnetic meridian; then a smaller parallel ruler and protractor will get the directions of the straight lines of streets or other details, and the crooked ones may be put in by hand. This plotting of the section requires to be done with as great care as the survey; and when it is completed for a section, all the details should be lightly filled in in Indian ink, and the pencil lines rubbed out, as this will make the work clearer.

Section after section should be surveyed and plotted in this manner, until the whole of the city or town, and as much of the environs as may be thought necessary, are included; and then the ground plan or map may be regarded as complete, at least in so far as position and distances are concerned.

In the plan of a town it is not desirable to show any of the inequalities of the surface by shading, as these only render the work more confused; and unless the environs are the principal object, even they ought not to be shaded. Indeed, when a plan or map is intended to show only distances and positions, the less shading that is upon it the better, as the shading only occasions confusion, and renders the consulting of the map a more difficult matter. For useful purposes, a clear map, which shows its information at once, is far superior to one which is attempted to be pictorial.

There is one addition, however, which it is desirable to make, and that is, some general indication of the summit levels, the lowest parts, and the general slope or slopes of the whole ground. In such a city as London, with its surrounding cities and boroughs, where the whole is crossed by a large river, that river will generally be the lowest part, and that to which the drainage must be conducted. The summit levels and the intervening depressions, make angles with this river, and the centres of the depressions are the situations for the main sewers or drains. These should be marked at convenient points; and if the height in feet and inches of each be inserted, the map will be all the more useful. These points must be levelled for; and as they can very rarely be all taken in one continuous line, the operation is both nice and tedious, as there will have to be levelling up a slope, along the height of that, and down again to the point in the greatest depression. Thus, for example, if, in the present state of London, the level of Fleet Ditch were ascertained up to Holborn Bridge, and the next point to determine the position and elevation were to be somewhere near Hockley in the Hole, one would have to level up Holborn Hill to Hatton Garden, and then along thence to the point to be determined; and if the first part were, as it would be in this case, an elevation, and last point a depression, the depression, subtracted from the elevation, would give the difference of level between the two extremities. The summit levels are found by levelling in the cross direction; and they are of use in determining the lines of culmination from which the secondary sewers are to diverge. The data thus found are of considerable importance, as they point out not only the best positions for the drains, but the cheapest method for forming them: as when they are in the lowest ground there is always least expense in excavating for them. The summit levels, with their height, should be marked at convenient points, in the same manner as the principal depressions; and when these are marked, and the names filled in, the map or plan is complete.

Notwithstanding the obvious importance of thus ascertaining and marking the principal elevations and depressions, we have never seen it attempted in a map of London, or of any other British city

or town. It is, we allow, far inferior in usefulness to Mr. Denton's plan of model mapping, of which we gave some account in the preceding number; but it is not so expensive in the execution, and the map can be carried about from place to place by surveyors or superintendents, which would be impracticable in the case of the model.

The matters noticed in this short paper are very simple ones, and such as might suggest themselves to any one capable of using a map or plan, but we doubt whether they have been attended to in the majority of cases, or indeed in any one case; and yet, for any other purpose than that of a street guide, an incorrect map of a town is both useless and mischievous; and, though it would, no doubt, be complained against as an interference with the right of the subject, "the divine right" of doing things wrong, it were well if some law existed, prohibiting any bungler from destroying the British metropolis from mere mercantile cupidity.

We readily admit that no private individual, or mercantile company, could afford to get an accurate map of London, because no sale that could be expected would pay for it, far less return a profit. But still a correct map is essentially necessary, and imperiously demanded for public purposes, and therefore it should be procured at the expense of the public.

TRICKERY OF ARCHITECTURAL COMPETITIONS.

In competitions by tender for the execution of work, there is sometimes a little trickery; for the parties do occasionally advertise for tenders, or estimates, after having made up their minds that the work shall be executed by a certain party, and no other. This is no doubt a fraud, because it is intended to hide from the public the already decided purpose of the advertisers, and make that seem a fair and open competition, which is, in reality, a mere juggle. In these matters, however, the cases are not very numerous, because, if the committee receiving the tenders are numerous, and not completely at the beck of some influential member, it is not likely that they shall all agree as to the favourite to whom the work is to be given as a job or bonus. There is another thing,—estimates made from specifications are mere matters of routine, costing little labour, and requiring no study or exercise of genius.

When, however, we come to architectural competition—or rather to what is so called—the case is very different. Architectural designs are not palpable to the public, generally, as matters of pounds, shillings, and pence, like tenders for work, and, consequently, trickery may be carried to a great extent in them, unperceived and unfelt by any except those who suffered by the fraud. There are two species of fraud which may be practised here: first, the advertisers may, previous to advertising, have made up their minds as to who shall be their man; and in such cases—which, though not universal, are, we fear, too general—the advertising is a mere blind to the public, and a gross and cruel imposition upon the competitors. Secondly, there may be fraud and imposition on the part of some of the competitors; and this fraud is generally effected by bringing forward showy drawings, and estimates along with them, far below what the work can be done for, even in the most vamped up and unsubstantial manner. There are two ways, in either of which this fraud may be perpetrated: the estimate may be false in all its parts, and not omit anything that is essential to the structure; or, again, the estimate may be true and fair, as far as it goes, but as much may be left out as may double and treble the estimated cost. In a great public work, in which the managers have no personal pecuniary interest, this is performed, or rather perpetrated, with no great difficulty. Thus, for instance, we have known of a large bridge having been constructed under an act of Parliament, in the progress of which the matter was sifted again and again by committees; and yet, when the bridge came to be constructed, it was found that no approaches to it were included in the estimate; and, though the price of the bridge was fair enough, the managers had to incur the expense of another act, and the contractors made them pay at least four prices for the abutments. In such a case, one would naturally suppose that there must have been a collusion between the architect and the contractors, but that was not mooted in time. It should, however, be useful as a caution; and the managers of works to be executed by contract, should never mind pretty pictures, which gloss over substantial faults, and convert the exhibition room into a toy-shop, but they should take care that everything is represented in the plans, and make the architect find security that nothing more shall be required.

These frauds are, of course, perpetrated chiefly in cases where the money does not come out of the pockets of the managers; for they who have craft enough to practise fraud upon others, seldom commit fraud upon themselves; and, for this reason, the greatest care should be taken in choosing the parties who are to examine the plans, and select one of them for that of the work.

All this is, however, a fraud upon the public, and upon the public only; but unfair decisions are a fraud, and a most cruel fraud, upon professional men, especially young men of energy and talent. There is cruelty even in a fair competition, because there is loss of time and study, and also disheartening, to all the candidates except the successful one. Say that the work is a church, which, from the populousness and wealth of the parish, is to be something more than common: a certain number of architects will direct the whole of their previous knowledge, and exercise much thought and study, in order to design something new and superior. This cannot be done in less time than five or six weeks; and we are aware of no law, and certainly there is no plea in justice or equity, upon which any man, or body of men, have a right to advertise for six weeks of an architect's time and labour, together with the benefit of his previous knowledge, and then *give him nothing for it!*

This falls most heavily upon young architects, and the more heavily, the greater that their talents are. They are the aspirants for fame, and it is monstrous that any committee of management should have the power of striking them down in their honourable path. The evil is heavy upon these injured parties, but it is still heavier upon the profession; and, were all the competitors for a public work to be fairly paid for their labour and study, the state of architecture would be very superior to what it is at present. A young architect, be his talents what they may, is not able to bear the same loss as an older one in full employment; and yet he is the man who is most likely to bring forward something original, because he has to study the subject thoroughly. The design which he gives in, is the product of his own invention and labour, which, in the ordinary run of buildings, is not likely to be the case with that given in by an architect already in full employment. The probability is, that such an architect will take from his well-stored portfolio a design already made, mark a few alterations with his

pencil, so as to disguise it a little, direct a scale to be made answering to the size wanted, toss it over to one of his drawing clerks, and, hey presto! it is given in as an original design, and approved of as such, and he who actually laboured gets nothing for his labour, and, what is more mischievous, his fondest hopes are blasted, and his energy in his profession paralyzed. This happens in, perhaps, the majority of cases, and the successful candidate gets the job, not on account of his design, for design he has none—or, if not on account of his name, his success rests on a baser foundation.

This state of things ought not to be tolerated; and, though favouritism walks in darkness, yet one slight improvement would be the paying of each candidate a fair price for his designs, this price to be returned by the successful one.

It may be said, that this fair remuneration for labour is quite unprecedented, that it is not given to contractors, or any others who give in tenders, and that, therefore, it should not be given to architects. But there is a wide difference between common tenders and plans for competition: the tender is a mere offer, whereas, the plans are the work itself, in so far as the architect is concerned. Supposing that a man wished to have a coat, or pair of breeches, and advertised for tailors to compete, by bringing the garments ready made, not a snip of them would pay any attention to the notice, but they would set the advertiser down as a madman. So, also, if a new bridge were wanted, and the advertisements for tenders bore that every candidate must give in a ready-made bridge, the advertisers would be thought fit only for Bedlam.

Yet, strange as this would appear, in the case of competitors in the execution of a work, it is exactly what is done with the architects in giving designs for it: they bring their work ready made, and, with one exception, get nothing for it, which is both cruel and unjust in the case of fair competitions, and deep and disgraceful iniquity in cases of unfair ones. But we are sorry to say that, foul or fair, it is the invariable practice, and, therefore, architects have to contend against a difficulty unknown in any other profession or trade. Young men of great talents and high spirit, which almost invariably accompany each other, are always most easily affected and disgusted by such a practice as this, and, therefore, those who are fittest to be the ornaments of architecture, and thereby the ornamenters of their country, are driven from their profession, or left in neglect and misery, dejected and heart-broken.

Since the commencement of our labours, we have received many communications upon this subject, though chiefly directed to the abuses of it; and, without adverting to the general fact, that the system itself is an abuse, we insert one of those letters verbatim as we received it.

TO ARCHITECTURAL PATRONS, AND PARTICULARLY TO THE COMMITTEE APPOINTED TO SELECT A DESIGN FOR THE NEW CHURCH AT CAMBERWELL.

"To such a creature truth is self-restoration; * * * But it must be truth without alloy, and unsophisticated."—COLERIDGE.

GENTLEMEN,

EVERY fresh opportunity for competition in architecture, instead of arousing interest in patrons for its professors, furnishes, on the contrary, a full fountain of animosities between them; and whether it is the architects or their patrons whom we are to blame as the cause of this unnatural state of things, it is certain—and I speak for the class to which I belong—that, except where a recent sting tempts them to forget their pride, contempt is the predominant feeling with the members of the profession, for those who preside over the business of a competition.

Separation and opposition deprive us of our corporate ideas; we forget in our selfishness that we belong to one another. *We* (I speak it with shame) act selfishly or dishonourably, forgetting that the cloud on our own fame casts a shadow on our whole body; and *you* (acknowledge the shame) put honesty and truth to pain, not remembering that the pang spreads like a rheumatism to every joint and limb of the nation.

Truth is a sacred jewel, in whose preservation and brilliancy we are intimately concerned. But, alas, it must be confessed, that, while we have bartered it for gold, you have soiled and lost it through ignorance, idleness, and self-conceit. Take an example: you would erect a new church at Camberwell; you issue well-considered instructions; you bind yourselves and us in honourable trammels; you take means to secure interest from interfering with honesty, and parading it before us too that you have done so. We scorn suspicion, and confine ourselves religiously to your instructions; and what is the result? That some among us are base enough to send, and you dishonest enough to receive, drawings which your word had bound us to withhold. You did well to desire that perspective drawings should be completed in sepia; whether or no you did well to confine us to one perspective view is not a question now; you thought, and declared accordingly, that you would receive no coloured drawings, and but one perspective view. Have you redeemed your pledge? Has truth met with justice at your hands? I put it to you as gentlemen; but you perhaps smile at my even endeavouring to ground an accusation of a disregard of truth on so small an incident. Did you hold such language when your child stole a penny? Did you not rather explain that the principle of honesty was as fully developed in the system of a farthing as in that of a pound. And then is it so insignificant an affair? Men were informed in what particular position they would be placed on a certain occasion: for that position they prepared themselves. Three or four, at the time of action, imagined that they would be safer in another (another, remember, which they had been authoritatively told that they could not occupy); and for form's sake the fifty-six were removed to that other ground.

But another charge in my impeachment it is still in your power to refute, and to make me blush that I have lodged it against you. Compel the architects whose design you have chosen, to execute it as you intended to have any design executed, and as they intended you to believe that they would execute theirs, with honesty in scheme and detail, for the sum for which you have their written promise to perform it. I should give them the lie, if I were to state my *express opinion*, that they *cannot*, and *never dreamt that they could*, perform their engagement. But I may, without offence, be allowed to give the reason of my anxiety to see them put to a *strict test* on this important point. A certain design for this church, of ample size, and of fair, but not extravagant richness, to my certain knowledge, would consume the whole of the allotted sum, in order to carry it out with credit to its author. Reason how *you* will, *I* have but one way of reasoning, when I see that you have chosen a design, all of whose parts are larger than those of the one of which I have spoken, while some most important parts are twice as large, and its enrichment is in every respect twice as florid.

If I am correct, believe me you are morally liable for the value of the fifty-nine rejected designs, and also for an amount of sorrow, labour, and disappointment, which a deep search into the studies and garrets of many ardent and deeply-injured young men can only discover.

"Beware of contempt," a wise man advises; but he might have said too, beware of giving cause for it. If we have just cause to distrust an inferior, we put ourselves to watch him; from an untrusty equal we separate ourselves; but one who by any occasion is our superior (such is a patron to an architect for the time being), because his place, with honesty, demands respect; so his place, unworthily occupied, inevitably brings him into contempt: so, at least, the virtuous feel. And the consequence of dishonourable dealings produce similar feelings in those to whom the immorality of the action is of little concern: those, of course, excepted, who are to profit by the violation of truth.

Do patrons, who sit down with honest intentions to their undertaking, know what they have to hear, to do? Do they know that the accumulated weight of every mismanaged competition is fixed upon their shoulders? With this imposed, that they have to wade through the slough of lying, trickery, and roguery, which has sprung from the contempt which I have pointed out. This, as an original difficulty, and then the danger of handing the whole, increased by their own act, to the next adventurer in this difficult field, if but the smallest slip of ignorance, cowardice, or vice, betrays the truth which they hold. Do they consider this, and that they are responsible members of a nation; and that their attempt to advance science supposes a wish to encourage virtue, and which attempt, from its direction, connects them with a zeal to advance the deepest spring of virtue—religion.

I suppose that not any consciousness will stand in the way of my having the credit to which I lay claim, in regard to every thing but the general principle of being,

A Free Witness.

SUSPENSION BRIDGES IN THE REGENT'S PARK.

SUBJECT OF THE PLATE.

When its gravel walks are completed, and afford dry footing even in sloppy weather, the Regent's Park will form a delightful promenade, both in summer and winter, to the dense population by which it is surrounded. It is by much the largest of the public parks in the vicinity of the metropolis; and the view which it commands is a sort of amphitheatre, the boundary of which expands as one ascends the elevated part of it toward the east. The view toward Hampstead is rural, as the plantations conceal all the buildings in that direction, except the villas which are situated within the park; and as these are neither numerous nor crowded, nor have much of the air of the town about them, they harmonize well with the foreground, and the trees and hills beyond. The other buildings, which extend along the remaining sides, have no great claim to architectural beauty, and some of them are quite deformed and ugly; but still they screen off the still inferior buildings and the thoroughfares, and thus give a quietude and repose unknown in any of the other parks. They might certainly have been very much better; but even the worst of them are better than nothing; as they give this park an exclusive air by shutting out objects which are still more offensive.

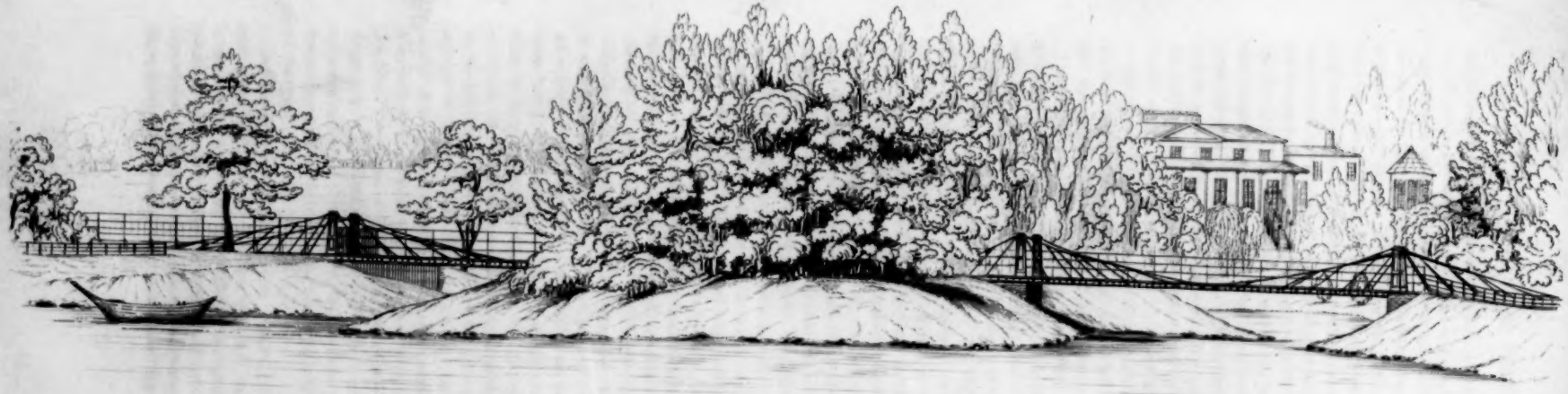
The decorations of the ground itself are judiciously distributed—there being most ornament where the view is most confined to the park itself. This is toward the west end, where the ornamental water, the artificial islands, and most of the clumps of planting, are situated. The islands are too small, and they want little extents of glade to break the monotony of the thick trees, which have something the appearance of baskets of tall bushes floating on the water. The main land, if it may be so called, is a little better, but even on it there is some room for improvement. The walks, so far as they go, are passing well; but the lines in which they appear to be laid out, have more resemblance to passages leading to points, than to pleasure-walks for the mere purpose of sauntering along. In mentioning the walks, we regret to see that the people have already begun to show their bad taste in spoiling every thing which is ornamented for even the very purpose of giving them pleasure. It is true that they have not yet begun to break and disfigure the trees—and indeed the trees are not of species very much calculated to tempt them to this outrage; but, notwithstanding the wet season and sloppiness of the ground, they have begun to patter down the turf by the side of the finished part of the walk. For their own sakes, they ought to abstain from this; as, besides the air and exercise which it affords, a park of this kind should teach the populace to respect and take care of what is beautiful; and this is a good school in which to learn the most useful virtue of taking care of every thing, a virtue in the practice of which many of the London populace are sadly deficient, with regard to the property of others, and even to their own property.

Of all the subjects in the Regent's Park which attract the attention of the observant, none are perhaps more worthy of attention than the suspension bridges now in course of erection by Mr. Dredge. From their extreme lightness they are better suited for foot-bridges, either in ornamental or useful situations, than bridges of masonry, carpentry, or iron, in imitation of the common arch. Span for span they are lighter, and only a small portion of the expense, though they are stronger and more durable than any others of moderate price: the reason is, that these bridges are not loaded with more weight than is requisite for strength; whereas, other bridges are often loaded with ten times more of their own weight than is wanted, and all this surplus conduces to weakness, not to strength. If a comparison were to be made, the same sort of relation would be found between these suspensions and the architectural bridges, as exists between Gothic and Grecian or Roman architecture: the former of these is constructed upon scientific principles; the weight of the roof and other suspended parts is divided into thrusts upon the ribs, and by them propagated to the spandrels, buttresses, and other points of support. And though the great age of many of these structures proves that they are abundantly strong, no part is loaded with any more materials than is absolutely necessary. These, which, though imitated in modern times, are merely imitated in form, and what are the real supports in the genuine structures are merely daubed on in stucco, are the *chefs-d'œuvre* of the building art. The classical ones, more especially the Grecian, in which even the arch is not introduced, are very different; for, whatever may be said of their beauty, their stability depends wholly on the strength of the materials; and as they are over-loaded on the top, the lower parts have to be made so massy so as to be quite unsightly.

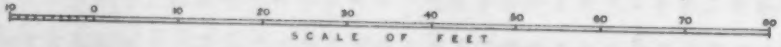
It is the same with bridges of masonry: the vast mass of the

DREDGE'S SUSPENSION BRIDGES IN THE

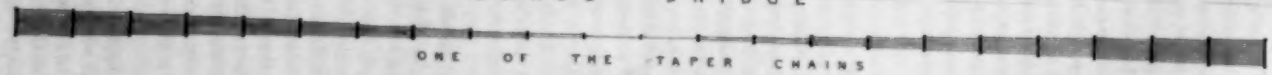
DREDGE'S SUSPENSION BRIDGES IN THE REGENT'S PARK.



TWO SMALLER BRIDGES



LARGE BRIDGE



ONE OF THE TAPER CHAINS

PART OF PLATFORM

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Engraved by J. Dower
From a Sketch by J. Dower Junr

arches requires piers of great thickness and weight, and these, with the forming of proper foundations, generally, if not invariably, cost more than a complete suspension bridge on the improved principle. Stone or brick is efficient only against a thrust, which, if applied as a pressure downwards, it will resist until it is crushed by the load. But the thrust of a bridge cannot in any case be wholly reduced to a vertical pressure; and here arises the necessity for strong abutments and heavy loads on the haunches of the arches. The strength of cast-iron is also chiefly against a thrust, though, when of the best quality, it will resist a pull or a cross strain better than stone; but still, cast-iron bridges, if of any considerable span, require to be of great mass and weight. Wood is both a strut and a tye; and hence a well-constructed wooden bridge is pretty strong in proportion to its weight; but it has the disadvantage of being the least durable of all bridges. Wooden bridges, too, especially the larger ones, are of the very worst construction—that of posts and lintels. Of these we have ugly instances at Putney and Battersea, where they spoil the navigation of the Thames, and are a disgrace to the country.

Malleable iron is not good as a strut for resisting a thrust; its great strength consists in resisting a pull as a tie, and in this it is superior to every other material that can be used for bridges. Against a cross-strain it is very inferior, and the more so the better that its quality fits it for being a tie; and therefore it ought never to be subjected to cross-strains, except it is in very short lengths. But when its strength is properly applied, it is most valuable, and if protected from oxidation it is very durable. The danger of subjecting malleable iron to a heavy cross-strain was most painfully shown in the destruction of the Brunswick theatre some years ago. The external walls of that structure as well as the roof were fireproof; and the walls were intended to support nothing but the roof, and the roof nothing but itself. For this purpose the framing of the roof was formed of malleable iron bars, of such strength as to support themselves and the covering, and nothing more. In some parts of this roof, the iron bars acted, in part at least, as struts, and thus they were not in the most advantageous position; but they were in comparatively short lengths, and the structure was, upon the whole, as perfect a structure as could have been made of the same material; and if it had been left to the duty which both the architect and the maker intended, there is no doubt that it would have stood for ages without any repairs. But, in the face of a protest from both of these parties, the proprietors, who were men totally ignorant of even the simplest elements of mechanics, went on hanging to the tie-beams of the roof those workshops and other matters which the architect intended to support on secondary walls within the fire-proof building, until the weight so suspended amounted to many tons. This weight drew down the ties with the power of a swig or funicular machine, pulled in the bight by some hundreds of men; and the result was what any one in the least acquainted with the subject might have foreseen: the rafters were drawn from their connexion with the walls; walls and roof fell with a tremendous crash; and, among others, the party who had contended most strenuously for the suspending of the weights, perished in the ruins.

Some may imagine that this is an episode, having no relation to suspension bridges; but, instead of this, it is an illustration exactly in point, more especially to Mr. Dredge's improved suspensions, in which the grand advantage lies in diminishing the cross-strains, and almost entirely getting rid of them at the centre of the chains, the place in which they are greatest in bridges of the previous construction. Chains of uniform thickness, and vertical rods to support the roadway, are the objectionable parts of these bridges; and the chief advantage of Mr. D.'s improvement consists in getting rid of them. The useless weight in the central parts of the uniform chain, is propagated toward the abutments; and, though the chain is weakened in many parts, the weakness is greatest there. This would be the case even if there were no roadway; and a chain of uniform thickness would break down by its own weight at a much shorter span than a taper chain. But when a roadway supported by vertical rods is added, the weakening and danger of fracture are very much increased. At the centre, the weight of the road and of whatever may be passing, acts as a direct cross-strain upon the chains; and though some part of the strain is propagated toward the abutments, where the chains are weakened by the weight of the centre, part is also propagated toward that. This was very clearly shown in the experiments by Mr. Dredge with his models—and, in such a case, one fact is worth a hundred arguments where these agree with mathematical conclusions; for in practical mechanics, no mathematical principle applies exactly. In the case alluded to, Mr. D. used a common spring steel-yard, as the central and connecting link of his chains; and when he attached the roadway on the vertical plan, and pressed on that roadway with both his hands, the steel-yard was tightened and drawn out till it showed a pressure of 40 lb.; but when he attached the roadway by suspensions upon his own oblique plan, the steel-yard hung loose, showing that there was no tension whatever on the central parts of the chains. The fact is, that, with this oblique position of the rods, the additional tension from a load on the roadway is thrown toward the abutments, and from the centre; when, therefore, the roadway is pressed down by its own weight, and that of whatever may be upon it, the action of the rods becomes much less a cross-strain upon the chains than a pull upon them in the direction of their abutment ends. It is this getting rid of cross-strains, and thus employing all the iron that has weight or tension to bear, placed in directions the nearest possible to that of its greatest possible strength, which is the essentially distinguishing principle in these bridges, and makes them superior to all others in strength, in durability, and in economy of construction.

We have often heard that the fag-ends of the professions have a great dislike to these bridges; whisper runs that men of greater name and more lofty pretence look upon them somewhat askance; but it is only of late, and by accident, that we have read any thing against them in print. The writer to whom we allude makes an assertion that Mr. Dredge's bridges are not new; and that, if they are so in any portion, they are worse for it than the pre-existent bridges. We shall quote the substance of some of those assertions, or assumptions, because the making of them shows that the public are not so well acquainted with these structures as their public usefulness and economy deserve. It is true that, in order to give what he asserts the air of being *treu und fest*, he pegs and nails it with exerpts of mathematics and mechanics.

We have already said, that the principles of neither apply with perfect accuracy to practical cases; and we repeat the same, because they who are most forward to appeal to these sciences, are sometimes already the foremost in error, or the most prone to fall into it. The great themselves occasionally nod over their propositions and formulæ, and the small take the start of them by sporting a little mathematics, when they have finished the easy joining to their wit's end. Of the truly great, we may mention La Place as an

instance. His *Mécanique Céleste* is truly a splendid book, and one with which the reader gets pleasantly on after he has once fairly started; but there is at the beginning a lemma or scholium, we forget which it is called, that involves a theorem which demands demonstration, and yet which cannot be demonstrated as it ought to be on the principles of geometry. The theorem is this:—"If two forces are represented by two sides of a rectangle, the resulting force will be expressed by the diagonal of the rectangle, *and it will have the direction of that diagonal.*" The first part of this theorem is easily demonstrated by common geometry, because it is easy to show, that after taking away the lost part of the forces—which produces no resultant action—the remainders are together equal to the diagonal. When, however, we come to the second part, which we have marked on italics, we are thrown upon an undeterminate case of triangles, and geometry breaks down as wholly inadequate to determine the direction. Now, when in common geometry an element is wanted, and the case thereby becomes indeterminate, there are no means of supplying what is wanted, either in algebra or in the higher geometry. These can no more create an original datum than they can effect any other impossibility. They are analytical sciences, and though by analysis we can separate the parts of what is complicated, and find their relation to each other and to the whole, yet no analysis can add even the smallest part to that which is analysed. La Place attempts this, however, and though he succeeds in making a show of mathematical learning, and draws the conclusions which he wishes to draw, yet, though we have consulted some of the ablest mathematicians upon the subject, we never found one who understood how the conclusion could be arrived at from the imperfect data. Conclusions drawn from formulæ are often rather curious matters; for it is possible to prove by a most correct algebraical process that 1 is exactly equal to 2. This arises from equal quantities in value, the same quantity being expressed in different terms, and the equation is worked until it comes to the same letters and signs on each sides, only one side has 2 for a coefficient, and the other has only 1. Of course dividing gives 2 for the one quotient, and 1 for the other. It is true that, notwithstanding this difference of expression, both terms of the division are equal to 0; and 0 can be got out of 0 as often as one pleases. We mention this, to show that algebraical expressions and formulæ are sometimes edge-tools, with which it is somewhat dangerous to meddle, except for those who are well acquainted with them; and having said this, we proceed to a few of the objections taken to Mr. Dredge's bridges.

First. "They are not new; and the reason is, that a taper chain has, the author believes, been actually adopted for the large suspension bridge erecting over the Avon by Mr. Brunel." This quotation, short as it is, contains some contradictions of the author's other statements, and some matters which are not exactly true. According to the writer's own showing, the chains suggested for the bridge across the Avon were not to be tapered upon Mr. Dredge's principle, but upon that of the varying tension of the chains themselves, without reference to anything to diminish this tension towards the centre; and thus the central parts of the chains were to be much thicker, and consequently to require more iron and more expense, than if they had been formed upon Mr. Dredge's principle. Therefore, it is perfectly clear that Mr. Brunel did not intend to adopt Mr. Dredge's principle, and that the author in question did not understand it when he made his remarks. Again, as to the priority, a bridge on Mr. Dredge's principle had been erected by him across the same Avon at Bath, several years before the subject of taper chains was mooted by Mr. Brunel, and that bridge does its duty well, and will be long ere it needs any repair. Farther, the bridge at Clifton, we believe, instead of "being erecting," is standing still, and appears very unlikely to be proceeded with, both on account of the dangers of such casualties as have happened to the Menai bridge, and of the enormous cost.

Secondly. It is asserted that, if there is any novelty in the invention by Mr. Dredge, he "has proposed a form inferior to one that would always be employed when rendered proper by attendant circumstances." What these "attendant circumstances" may be, we pretend not to know; but if the whole tension were produced by vertical rods supporting the roadway, it is very likely that Mr. Dredge's chains would be too slender at the middle, in proportion to their thickness at the abutments; but the tapering of the chains is but one part of the improvement, the object of which is to get rid of as much weight at the centre as possible; and it cannot be fairly judged of except in conjunction with the other part—the position and action of the suspending-rods.

Thirdly. The writer in question takes an objection to the oblique position of these, and thinks they will not be strong enough for the duty they have to perform; but, judging from his words, and also from his figure, which is as unlike Mr. Dredge's structure as it can well be, he seems not to understand it. If the rods had nothing to do but support a weight at their lower extremities, then it is quite true that vertical rods would be the strongest, that is, if the oblique rods had only to support a perpendicular pull downwards. But, in that case, there would be no assistance of the one to the other, but each in succession would have to carry the whole burden of any passing weight. The oblique rods, however, act in concert, and distribute the weight over a considerable length of the chain, and, consequently, throw the strain, in part at least, upon the adjoining rods. Thus, from their position, and the fact of their being moveable on the bolts which connect the joints of the chain, and the rods themselves with these, they are, to some extent, auxiliaries to the chains, while vertical rods are merely weights hung upon them. When there is more than ordinary strain upon the rods, which can happen only when heavy weights are passing, they tend to draw the chains down, and the platform upwards, though they do the latter only to a very slight extent,—an extent which is hardly perceptible. Hence, additional strength, though not to any great extent, is given to such a bridge, by the platform descending a very little toward the middle, though the descent should never be such as to give an unseemly appearance. It is the action of the oblique roads which allows of so great a reduction of metal in the centre, not only with the same strength, weight for weight of iron, but with equal strength, and a great saving of material and cost.

Such are the general principles in the construction of Dredge's suspension bridges, with regard to the chains, the suspending rods, and the roadway; and there are many other advantages. From its form, this description of chain does not require so deep a curve as the catenary of a uniform chain, or of that chain reduced only in the law of its tension in the different parts. Hence the towers do not need to be above half the height of what would be required for a catenary; and thus, whether the towers are of masonry or of cast iron, the cost of them is considerably diminished. Besides this, the action of the wind upon the structure is by no means so great, and its tendency to vibrate at the middle is much less, and reduced almost to nothing by the stiffness of the roadway, if that is framed

as it ought to be. It is the vibration of the chains, overloaded at the middle, and with deep curves, which is the primary cause of all those motions, cross, longitudinal, and oblique, which end in the fracture of the rods, and the disruption of the roadway, such as have happened at the Menai bridge; and from these, a bridge upon Mr. Dredge's principle would be free, except it were of vast span, and in a situation of extreme exposure.

Other advantages of these bridges are, their simplicity, their portability, and the ease with which they can be erected or taken down. They are so simple, that a child can understand them. The parts want no numbering; for, though the sets of pieces vary with their uses, all that belong to one set are exactly the same; and in addition to these, there are only a few screw-bolts and screws. In portability, the whole bridge, with the single exception of the masonry of the abutments which supports the cast-iron towers, may be packed in a few boxes, and sent from one end of the island to the other, with great facility, and at little expense. On land, the whole bridge might be carried fifty miles, at less cost than the rough materials of a stone bridge of equal span, even though those were to be had at a place only one mile distant. This arises from the great economy of materials, and from the whole iron-work being finished and fitted at the manufactory. When the masonry of the abutments is ready, and the mortar has set, which it ought to be allowed to do before the iron is put in its place, the erection of the bridge is a simple matter, and done in a short time. The iron towers have to be screwed down firmly on the bolts in the strong casing of the masonry; the chains and suspending rods have to be bolted together, raised till the clamp plates are on the tops of the towers, the tail chains outside the towers well fastened at their extremity, and the caps of the towers screwed down over the clamp plates; and this being done with each chain, the whole is ready for attaching the roadway. The first thing to be done in this, is to attach the main longitudinal beams to the suspending rods, of which there are two at every joint of the chain, one to be attached on each side of the beam, and adjusted to a uniform bearing by means of the screws; then the cross beams are to be put in, and after them the intermediate longitudinals, which, having only the paving of the roadway to carry, may be much more slender than the lateral ones. If cross ties are required in a diagonal direction, to give stiffness to the platform, they also are to be put in, and all is ready for the pavement. This is, in general, best laid on planking; and, for a foot bridge, the upper pavement may be stone or asphalte; but if there is a carriage-way, wooden pavement is much better for that than broken stone laid on cement; and the foot-paths, if any, should be asphalte. The platform being completed, the parapet railings are to be put up, and the whole bridge is finished. If everything is ready, a few workmen can, in not many days, put up a moderately sized bridge. It sometimes happens that a bridge is not erected in the proper place, or improvements of the adjoining grounds may render improper, a place which is well chosen at the first. In either of these cases, it is desirable to remove the bridge from the one, and erect it at the other. In the case of a stone bridge, at least where materials are close at hand, the taking down, removing, and rebuilding, cost nearly as much as a new bridge, while the bridge itself is very inferior. In the case of these suspensions, the only parts sacrificed are the paving of the platform, and the abutments of masonry; and the sacrifice in the first case is only partial, while, in the second case, the abutments may be taken down, removed, and rebuilt. In the other parts, nothing is lost; for reversing the process of construction takes down the iron without injuring a single piece; and, when it is brought to the new situation, it may be put up with the same facility as before. Where the vicinity of a town, or any other populous locality, is rapidly changing in the way of improvement, this facility in removing a bridge from one situation to another, is a matter of very great importance.

There is one very considerable saving effected by adopting these bridges in situations where the banks are very little elevated above the river across which the bridge is to be thrown. If the span is considerable, the crown of the arch, whether made of masonry or of cast-iron, must have considerable elevation; and, unless the bridge is to be both unsightly and difficult of passage, the abutments must be extended a considerable way, and the approaches still farther beyond them. The former of these, at least, must have stout containing walls, with cross walls, if the bridge is large and heavy, and the lateral thrust great; and if these abutments and approaches are high, they may be pierced with land arches. Whether done in this way, or by solid embankment, the expense is great, greater, certainly, than that of a suspension bridge of equal span; and, for such a bridge, no expense of this kind is required, unless where the platform has to be raised in order to accommodate a navigation.

From what has been said, it may be very fairly inferred, that, in every situation, suspension bridges on the improved principle are equal to bridges of masonry, in point of strength and durability, and that they are more commodious, and may be obtained at a fraction of the cost. In ordinary cases, they may be made to span from bank to bank in one single stretch, and thus they require no coffer dams, no piers in the water, and no piling of the foundations, except in rare and very peculiar instances; for, if the ground is of any tolerable consistency, a proper stratum of concrete, flagged over with strong paving stones, will be a sufficient foundation for the abutments of any suspension bridge. It is to be borne in mind, that neither these abutments, nor the towers which they support, are exposed to any lateral thrust; the chains of the arch adjoining the abutment have no doubt a tendency to pull the abutments and towers inwards; but this is exactly counteracted by the tail chains on the land side of the towers and abutments; and, if the bridge consists of more than one arch, the intermediate towers are pulled equally in opposite directions: thus, there is no lateral pull upon the abutments and piers of a suspension bridge, any more than there is lateral thrust—the whole strain upon them being reduced to the pressure of the chains and roadway perpendicularly downwards, in the direction of the axis of gravitation. All chain bridges are free from lateral strains or thrusts, and thus have to support only a downward pressure upon the towers; and the great reduction of this pressure is the advantage possessed in this particular, by Mr. Dredge's bridges. But suspension bridges are not only equal to any other bridges, and far cheaper; but they are especially applicable in those situations where arched bridges, of whatever material they are composed, are the least applicable. In some cases, the difference consists simply in appropriate beauty, but there are many others, in which it has advantages of a superior kind. For bridges in pleasure grounds, and more especially foot-bridges, these suspensions have a finer effect than any others, as they do not require any alteration of the natural elevation of the path, nor do they in the least interrupt the prospect—they themselves being barely perceptible when seen from a moderate distance.

Across dry dells, or the dells of mere brooks, whether the brook be concealed in a sewer, as is the case in towns, or open, as in the country, they are the very best.

Over rivers in flat districts, where there is no navigation by masted vessels, they are also most advantageous; and, indeed, they are especially the bridges fitted for low and flat countries, whether the banks are nearly level with the water, or raised considerably above it. If the banks are high, they are equally convenient, even though there is navigation by means of masted vessels; and, in every case of navigation that can pass under a suspension bridge, there is the whole width of the river for accommodation and safety, whereas, there is always confinement and danger in sailing or rowing below a bridge which has many piers in the water; for neither the river stream, nor the ebb, passes through, or issues from, all the arches in parallel portions, which do not disturb each other, but, on the contrary, there are invariably cross currents and troubled waters, and eddies, which require not only dexterity, but local experience, to pass through them with safety. These disturbances of the water are occasioned by different depths and velocities in the different arches, by the form of the shores both above and below, and by bottom banks, which are continually shifting by the cross action of the disturbed water; and, on account of the latter circumstance, passing under a bridge becomes, in a year or two's absence, dangerous to those who were previously well acquainted with it.

In flooding rivers, especially those which swell by mountain rains, and rush along rocky channels with great impetuosity, suspension bridges, now that the true principle of them is known, may be said to be indispensable. Such rivers not only send down a great volume of water with so much velocity that it is capable of overturning a pretty strong bridge, but they also drive along vast masses of stone, which, impinging on the piers with great force, are sufficient to destroy the strongest bridge. This was exemplified in the bridge of Ballatter, across the river Dee, in Aberdeenshire, only a few years ago, and it was not till 1815, when the one-arched Waterloo iron bridge was thrown across the Conway in North Wales, that there was any security for a bridge across that rapid and turbulent river, at the place where a bridge is most desirable. Previous to that period, successive stone bridges had been erected with one pier in the middle of the stream; but the floods of the Conway roll along immense masses of stone, by which, and the force of the current, the bridges were assailed, never stood more than a few years, and sometimes were destroyed in the first flood season after their erection. In such situations as these, more especially where there is little traffic to repay the expense of a bridge, Dredge's suspensions would be the greatest improvement ever introduced. Across mountain ravines, too, where there is little or nothing to repay the expense even of foot-bridges, and in all situations where foot-bridges are necessary, the advantages of Mr. Dredge's plan are almost incalculable. One of them is, that there might, were it adopted, be nine or ten bridges for every one; and, as in many districts it is a long distance to go round by the existing bridge, to a place directly opposite, and not many hundred yards off, the accommodation and the saving of time would be great and important.

It may be said, that government—that is, the public—should be at the expense of all highways and bridges, which the people of the local district are unable to pay for; but, even granting that they were, government, which should be a strict economist, ought not to pay nine or ten prices for every such bridge. We believe that there are upon the record but too many instances of over-payment for public works; but this is gross injustice, on the part both of the payers and the paid, and it ought to be put an end to.

In as far as bridges are concerned, Mr. Dredge's invention is among the greatest improvements of modern times, if it is not the very greatest. It differs from all other improvements of a similar nature, in that it affords a better article at a lower price, while in every other case, the price has been increased very much in the ratio of the improvement. Mr. Dredge, therefore, eminently deserves public encouragement, in the utmost extent to which it can be given; and this, not as a tribute of gratitude to him, but as an act of justice to the public themselves.

REGENT'S PARK BRIDGES.

(With reference to the Plate.)

Of these, we need only to give a few hints, and these statistical, rather than descriptive. All the three bridges are sketched as seen from the open part of the water, and the wooded islands, and some of the clumps on the shores, are lightly sketched in, to furnish some idea of the effect. The smaller bridges are but partially shown, because there is not a point near enough where both are visible and whole; but the larger one is shown in full elevation, and as the smaller ones are, in their general form and appearance, miniatures of it, their likenesses are easily made out. The views from the water are important to every one who resorts to the park, because there is no point accessible by the public, from which a direct front view of either can be obtained.

SMALLER BRIDGES.

These, with the island between them, and a peep of some part of the Marquis of Hertford's villa in the back ground, are shown in the upper figure in the plate.

LARGER BRIDGE.

This is shown in the second figure in the plate, with the island, and part of the shores and water beyond.

The remaining figures on the plate show one of the chains, and part of the roadway.

STATISTICS.

Span of each smaller bridge 50 feet: height of towers from masonry 5 feet.

Breadth of roadway in each, about 8 feet 6 inches.

Total cost of each smaller bridge £187 10*s*.

Ditto, of larger bridge, £500.

In the chains of each small bridge, there are 140 links, 40 joints with bolts, 40 oblique rods for connecting the roadway to the chains, and 40 oblique mooring rods, altogether weighing about 15 cwt. The weight of the cast-iron towers, 15 cwt. The roadway with fences, is a wrought-iron frame, weighing 2 tons, covered with Yorkshire paving.

In the chains of the large bridge, there are 478 links, 80 joints with bolts, 160 oblique roadway suspending rods, and 80 mooring rods, altogether weighing 2 tons, 16 cwt. The cast-iron towers, 2 tons, 16 cwt. The roadway iron framing, with fence, is 5 tons.

DUTY ON CORN.

[THOUGH we are not in the habit of inserting articles with such titles as the above, lest they should be construed as having a political bias, which we wish above all things to avoid; yet, respect for the quarter whence the following short communication comes, the importance of the subject itself, and the fact of there being nothing political in what has been sent us, induces us to give a place to this paper. We might add, that, though not nominally connected with engineering, every thing which affects the productiveness or produce of the land, is in reality connected with it. In order that engineers, architects, and other professional men may be employed on works that are highly useful or ornamental, there must be surplus capital and revenue over and above what is required for their bare support; and the larger that this surplus is, the greater demand there will be for professional men, and the greater scope for the display of their talents.—COND.]

TO THE EDITOR.

Whatever appears in the newspapers upon such a subject as the duty on corn, is sure to be considered of a political nature; and, from the mere fact of its being so considered, the public cannot take a candid and dispassionate view of it. It is considered as being on the one side of politics or on the other, more on account of the paper in which it appears, than of any thing that the communication itself may advance; accordingly, it no sooner appears, than one party view it as their own, and praise it without knowing very well why, and the opposite party show their hostility to it upon nearly similar grounds; therefore, there is no possibility of bringing even the simplest and least political question fairly before the public in a newspaper; and in the present state of public feeling upon it, every thing connected with the importation of corn, or the duty on its importation, if it is brought forward in a newspaper, adds fuel to that raging but useless fire which had better be quenched. These are my reasons for soliciting a place in your journal, for the following very short remarks.

Ever since there was a duty on the importation of corn, whatever may have been the amount of that duty, and the ratio of its variety, as the price of corn varies, the Corn Exchange has become, to all intents and purposes, a gambling association. This has not been the case in Mark Lane alone, but has extended over all the country wherever there is a corn market. Besides the immorality of this, it is unseemly, and both an inconvenience and a loss to the people generally. Gambling on the Stock Exchange is bad enough, but still, if there is not a plea of justification, there is the shadow of one. In former times, the money for which the debts, called stocks, were incurred, was spent in a sort of gambling or wager of battle among governments; and, therefore, gambling in the funds was merely keeping up the system upon a reduced scale. But gambling in the first necessary of life is another matter, and a matter wholly objectionable. Yet, there will be gambling in this article as long as the system continues of lowering the duty as the market price rises. The holder of home-grown corn and the holder of foreign corn have opposite interests, and these are continually clashing with each other, causing a great deal of corn to remain in the granaries, and thus producing scarcity when there is plenty, and high prices when corn ought to be cheap. It appears to me, that there is only one way of curing this evil, and that is, to make the rise and fall of the duty take place along with, and in proportion to, the rise and fall of the market price. Many would object to this as admitting foreign corn when it is not wanted, and excluding it in those years when it is most desirable; but this would operate better than the falling duty with a rising price; and it strikes me that it would put an end to all gambling. The prudent way, unquestionably, is, to obtain and lay up a surplus, when corn is plenty and price is low; and this surplus will come in with great advantage both to the holders of corn and to the public, when the crops are deficient and price is high. To the farmer, this mode of varying the duty, so that it always bore the same ratio to the price, would not be an evil, but rather the reverse; for the farmer suffers more than any body else from light crops and high prices. It may happen that some farmers on forward spots, and with their land in the very best condition, may have fair crops in years of comparative scarcity; but there are, upon the poor bleak lands, farmers, whose whole produce does not support their families and establishments in very bad years; and as such farmers are tottering upon the brink of ruin at all times, the high price which they have to pay for the quantity they have to purchase, tumbles them down altogether; and this is one of the most serious causes of agricultural distress, and one which will continue to operate, as long as the import duty varies inversely as the market price. It matters not what may be the amount of duty, or the law according to which it varies, for whatever these are, the evil will continue to operate as long as they vary in opposite directions; and though high prices in years of scarcity may afford great profits to a number of farmers, there are many more who are ruined by them. Between the two classes of farmers—though they pass into each other without any definite boundary—there is the same relation that there was between the kine in Pharoah's dream interpreted by Joseph, only the lean kine in the dream ate up the fat ones, while the fat farmers eat up the lean ones.

The duty on corn does not profess to be laid on so much for the revenue, as for a protection to the farmer, and through him to the whole agricultural interest. But, without raising the question as to whether the duty does or does not afford a protection to the farmer or to any body else, I view it merely as a means of obtaining a portion of the sum necessary to support the general establishments, and pay the public expences of the country. Viewing it in this simple light, I must say, that the relief which it affords to the farmer is very questionable; and, besides, it leaves the corn trade open to that gambling to which I have alluded.

If a duty on the import of corn is necessary, then it should be an *ad valorem* duty—a certain per-centage upon the value, according to the state of the market at the time. This would enable the merchants to import when importation were most profitable, and it would give the farmer the greatest protection at the time he stood most in need of it: for it must be kept in mind that years of scarcity are those which fall most heavily upon farmers, at least, on the average, which is the proper rule to go by.

Along with this there ought to be no warehousing, but every one who holds corn should be allowed to bring it into the market whenever he is so inclined: this would go far in putting an end to gambling, and perhaps also to such complaints as at present set people together by the ears; and thus, in every possible view of it, it would be beneficial.

I have been the more induced to write this letter, and request your insertion of it in "The Surveyor, Engineer, and Architect," because you have announced your intention of treating agricultural engineering as a regular and systematical part of your work; if properly done,

this could not fail of being highly useful to all the parties concerned. The love of any subject is the grand means of bringing that subject generally and fairly before the public,—as by it the best treatises on the most important subjects are sooner and better made known than by societies, whose principles and practice are the very opposite of this.

As you justly remark, engineering has hitherto been too much confined to machines, and improved means and methods of conveyance, whether of human beings or of commodities; and there have been exceedingly few, if indeed any, instances in which engineering, upon what may be termed the grand scale, has been applied to the amelioration of the land, or the increase of its produce. There have been local improvements in a small way; but, because of the narrow range to which they have extended, they are imperfect even so far as they went. The improvements of one farm or estate have been narrowed and counteracted by the unimproved farms and estates about them; and when one farm has been brought into good heart and mould, and freed from weeds, the seeds of the most noxious weeds, which are always the most abundant, have invaded by legions, and soon in a great measure spoiled the improvements. The downy seeds of the composite plants, many of which are terrible scourgers of the soil, may, in the season of dispersion, be seen diverging toward the improved lands, like snow flakes before a winter wind, and the result has often been, that these plants have grown up in the spring, exhausted the strength of the land, and greatly impaired the value of the crops. What is first wanted, is, surveys of the different districts, with a view to their improvement; and perhaps I may, on some future, but not very distant occasion, send you a few remarks on the proper parties to be employed, and the right way of performing their duty.

J. E. B.

THE WESTMINSTER REVIEW, No. LXXI.

For some time past a most strange change for the worse has come over the Foreign Quarterly. That publication, which used at one time to give us many interesting literary and artistical papers, including among the latter not a few ably written architectural articles, seems now devoted to antiquarian rigmarole, politics, and dulness. In fact, it is either be-devilled or be-doctored, perhaps both, being be-D.D.'ed with a vengeance. Even the great Albemarle Street Quarterly, which was long in the habit of refreshing us every now and then with a good architectural article, seems to have abandoned such papers altogether. As to the Edinburgh, that was always innocent of them, and seems likely to remain so. The Westminster Review, on the contrary, has in its last No. assumed a character almost decidedly architectural, for it contains two papers of the kind, both of them illustrated with several engravings. The one on "Metropolitan Improvements," is accompanied with no fewer than eleven plans, including two of the proposed Victoria Park; while that on the "Architecture of Shop-fronts," gives us some examples of designs of that class.

Although less important in its subject than the other, it is perhaps this last paper which will be found the more interesting of the two, for not only is it animated and lively in its tone, but will be found to contain many ingenious hints and valuable remarks. The writer commences by animadverting on the error into which architects are so apt to run, rioting in wild schemes and extravagant fancies, getting up exhibition drawings for royal palaces and royal marine villas, senate-houses, cathedrals, and other pompous affairs of the most visionary kind. Very justly does he remark, while adverting to the complaint frequently made, as to the want of adequate opportunities for the display of architectural talent:—"Opportunities! why we can hardly walk any where about town without seeing scores of opportunities that have been flung away,—crude architectural abortions, and fronts in which sordid stinginess, meanness of taste, and paltry extravagance accompany each other."

Of opportunity flung away, the British Museum exhibits a most flagrant and provoking instance, its exterior being of the most awfully dowdy description, no better than a huge brick barrack, not only destitute of all ornament, but also of any elegance of form and proportions. Look again at the Post Office, in which the portico alone is the only dignified feature, all the rest being equally mean and insipid;—at the Custom House, which, if it be a crude mass of paltriness and littleness, is not so for want of greater extent;—at the Conservative Clubhouse, where opportunity was afforded for elegance of design, if nothing further. Surely it was not for want of opportunity that Buckingham Palace is the disgracefully wretched and miserable thing it is, or that Stafford House is such an uncouth patched up structure, or that the church in Wyndham Place is so detestably barbarous in design.

To return to the writer in the Westminster—he recommends that advantage should be taken of such subjects as shop-fronts, for making trial of novel architectural detail, including inventions for capitals, instead of the eternally repeated Doric and Ionic, which, besides their sameness, have, when so exhibited, nothing of the dignity of the originals. He is also a strong advocate for covered streets of shops, that is, for what Londoners denominate "arcades," and the Parisians, "passages." And he further suggests the blank wall in the arcade on the west side of the Opera House, as a very suitable place for making some experiments in fresco-painting, relative to which there is just now so much talk among artists.

This No. of the Westminster is certainly one of unusual interest to architects, and we have no doubt our readers will thank us for calling their attention to it.

AGRICULTURAL ENGINEERING.

Sir,

That the time is not far distant when farming and agriculture will rank among the scientific occupations of the community, I am convinced by the rapid strides now making towards that end by the majority of those who follow the pursuit—and that we shall have classes and lectures, too, at the universities and schools, for the education of those whose intention it is to become farmers, in which will be taught agricultural chemistry, hydraulics, mathematics, and mechanics, is as certain as the fact that, up to the present generation, no class of men has been so deficient in general knowledge, and in those arts which now make agriculture so interesting to our farming landowners and gentry, as that which is termed, in national pride, "England's Yeomanry," and, in the division of the two great interests of the country, has claimed and possessed the greater power. However improbable it may now appear, it is the opinion of many, observant of the progress of agricultural

knowledge, that there will yet come a time, when landlords *will require* in their tenants a scientific education, as well as practical knowledge, in order that the lands they hold of them may not suffer from the prejudices inherited by men who regard the habits of their fathers and grandfathers as exemplary and infallible, and the improvements of science as the innovations of speculation.

Hence it is, that I believe you are not too forward in impressing upon your readers, under the titles of "Agricultural and Hydraulic Engineering," the advantages which may be gained by the observance and use of the natural, but now unheeded, resources of landed property. I do not allude to such works as the great levels of the fens, or the level of the Wash, or, in fact, to any matter which requires a company of shareholders to work it out, but simply to such works as nature more palpably points out to the mind of all lovers of husbandry, such as general drainage and irrigation, and the many available consequences which the former will afford to such as encourage it. To the minds of professionals, the steam-engine and the Belt instantly start up as the natural adjuncts and means of carrying out fully any engineering project in hydraulics, but to such extent my views do not go—nor do I deem it wise to distract the attention of agriculturists at the present era of interest in land and the corn laws, by advancing at all beyond that stage of argument which is suited to the anxiety and doubtful apprehensions of land owners, entertained by them, in conjunction with an earnest desire to proceed in a steady course of improvement. Any thing like theory startles them, and they turn to matters of fact and precedent, as the only source from which they believe it orthodox to gain information.

The various acts for drainage—commutation of tithes—and copyholds enfranchisement, are confirmatory essays of the increasing spirit of enterprise; but, perhaps, none will advance the improvement of land more than the act of the last Session "to enable the Owners of Settled Estates to defray the expenses of Draining by way of Mortgage," inasmuch as it may be presumed that, among the land owners of England, whose estates are entailed, are the majority of those enlightened men, who would afford, by their patronage of science, an example to those who require stimulating by precedents. What branch of agriculture has been so long delayed, what improvement is *now* so backward, as that of drainage? Half a century back, the waste land (composed of hedge greens, banks, and farm roads,) engrossed ¼ of the whole quantity of a farm: now, $\frac{1}{18}$ or $\frac{1}{20}$ is all that is allowed by good husbandry, so it is to be hoped will be the progressive and increased adoption of drainage—not by its paltry application to a single field, but by a general and systematic course, extending to the whole of an estate, or to the whole of a parish, where ¾ of the proprietors will engage, by compact similar to the arrangement required by the acts alluded to; the expenses to be paid by rate upon the landowners benefited, according to the advantage derived by either drainage, or *its consequence, Irrigation.*

Let me state the case of the Teddesly Hall estate, in Staffordshire, where Lord Hatherton has been benefited by this economic system, to the extent of a clear annual interest, on an outlay of £2733 2*s.*2*d.*, of 37 per cent. I speak from the author of "British Husbandry."

The estate contains 2586 acres, of which it appears 467 acres have been drained, and meadows to the extent of 89 acres have been irrigated by the drain water. This water has been collected into two main carriers for the purpose of employing them as a power to turn a mill wheel, and *afterwards* to be applied to irrigation. To concentrate the water in sufficient force to turn the wheel, a headway has been cut through a rock; nevertheless, the mill and this channel are stated to have cost no more than £1000. It works a thrashing machine, cuts hay and straw, kibbles oats and barley for a stock consisting of about 250 horses and cattle, grinds malt, and turns a circular saw, which does great part of the sawing of a large estate.

The expense of conducting the water over lands-*chiefly upland*, 89 acres, is stated as only £224 4*s.* 10*d.*

I extract the summary:

TOTAL EXPENDITURE.

	£	s.	d.
Underdraining, as per statement . . .	1508	17	4
For erecting water-wheel and machinery . .	1000	0	0
Irrigation	224	4	10
	2733	2	2

TOTAL INCREASE IN VALUE COLLECTED.

	£	s.	d.			
Lands underdrained, present value .	689	13	1			
" Original value .	254	10	9			
				435	2	4
Estimated saving by the mill . . .				400	0	0
Increase in value of water-meadows . .				178	0	0
Being an *increased* annual value of . .				£1013	2	4

And this has all been done by making use of means hitherto disregarded.

One more case I beg to allude to, and that is, the Greenock water-works. The town of Greenock is supplied with filtered water from reservoirs, in which are conserved the outpourings of several mountain streams, which, until the construction of the works, flowed into the sea at the mouth of the Clyde. These rivulets generally failed in dry seasons, and caused serious inconvenience to the inhabitants; but by the skill of Mr. Thom, the town is now regularly and plentifully supplied with excellent water without restraint, besides affording to several mills a large quantity from the reservoirs, which keeps them constantly at work,

I am, Sir,

Your obedient servant,

D.

REVIEW.

Müller's Picturesque Sketches of the Age of Francis I. Folio, 26 plates. London, Graves & Co., 1841.

Of architectural works, strictly so called, the number has in this country been exceedingly scanty of late years. Unlike their German contemporaries, those who have executed buildings of importance have not cared to publish such illustrations as would afford satisfactory information relative to them, almost the only instance of the kind being those which have recently appeared of Windsor Castle, and which are confined exclusively to the exterior of that pile, without even so much as any general sections of it. On the other hand, however, we have had several splendid works, consisting, some entirely, others very nearly so, of architectural subjects, graphically treated, and with far more of artistical feeling and pictorial effect than almost any former productions of the kind—thanks to the art of lithography, and to the extraordinary perfection to which it has now been brought by such true artists as Haghe and others.

When we say that Mr. Müller's drawings have been lithographed by Haghe himself and his assistants, hardly need we add that they are most admirable in point of execution, while the subjects are no less admirable in themselves; nor is our admiration unmixed with wonder that the picturesque style, of which we here meet with so many charming specimens, should hitherto have attracted so little notice either from professional writers or from travellers. Hardly a word on the subject of the French *Cinque cento* or *Renaissance* is to be met with in any history of the art, for, copying each other, our architectural pedants have evaded the subject altogether, doing no more than giving us to understand that the style itself hardly deserves the name of one, being little better than a mongrel capricious mode of building, reduceable to no fixed rules, and wholly unworthy of being named with that *classical* system established by Palladio in Italy, and introduced among ourselves by the "great Inigo Jones."

Fortunately such prejudices, akin to those which at one time prevented us from seeing any beauties in Gothic architecture, or any thing more than a lawless and capricious or gloomy and monkish style of building, devoid of proportions and harmony, are wearing away; and in some instances have been succeeded by a too indiscriminate admiration. As for ourselves, we abhor that narrow sectarianism in art which refuses either to acknowledge merit or admit defects, except as they belong to a favourite style or the contrary; and we deprecate that spirit of *nominalism* which attaches more importance to their appellations than to the things themselves. That the Renaissance style of France is marked by many notable defects, we do not deny, but it also possesses merits and beauties of its own, and which deserve not only to be admired, but to be studied. Most certainly it cannot be reproched for its insipidity, it being almost always picturesque—we might add *chivalresque*—romantic, and occasionally poetic. The architecture of the eighteenth century, on the contrary, may be said to have been the prosaic period of the art throughout Europe; for, with a few exceptions, its productions were marked by chilling insipidity, dull formality, and mediocre correctness, and by the utter want of geniality of conception. A sort of revival of both Grecian and Gothic took place before the century closed, but of neither style was the spirit understood in that age, as it has been called, of "milk and water taste, and white muslin." In fact, architecture seemed at one time to be almost on the point of being obliterated. From that languishing state, it has since somewhat recovered itself, and is beginning to shake off the timid servilism and fumbling pedantry, which had reduced what is, or ought to be, a fine art, to little more than a system of mechanical routine.

One consequence, certainly never contemplated, has ensued from the adoption of that cold and sulky-looking manner which for some years has been in vogue, and palmed upon us as a pure Greek style, notwithstanding that of Greek architecture it retained little more than its columns, while all that gave life and expression to the original style was omitted, as capable of being dispensed with—one consequence, we say, is, that, weary of so much sameness and insipidity, we have turned to other styles, and begun to make them the subject of inquiry and study. The one of which Mr. Müller has given us examples, is fraught with *gusto*, and is eminently impressive; too exuberant perhaps in "gorgeous fancies," and certainly admitting of considerable refinement, therefore not to be recommended for mere copying; yet, for the very reason that it would require to be more or less modified, does it deserve to be studied, as suggesting valuable hints and ideas to those who are capable of turning them to account.

The volume before us contains several subjects from the chateau of Chambord, Fontainebleau, Blois, &c., besides one or two specimens of ecclesiastical buildings; and the greater proportion consists of interiors, so that we are also presented with a series of illustrations, exhibiting the taste of the period in furniture and decoration, a taste greatly superior to the unmeaning gewgaw fashion called à la Louis Quatorze. The taste, or, rather, the tastelessness of that monarch led him to disfigure many of the monuments of the time of Francis, under the pretence of reforming them; and among others, such was the case with the chateau of Chambord near Blois, begun by its royal founder in 1526. This singular edifice, worthy of being carefully preserved as an historic monument of art, was so modernized—we had almost said "church-wardenized"—by Louis XIV., that of the original character of the exterior little more now remains than the roof, with its gorgeous array of rich dormer windows, turrets, pinnacles, cupolas, chimneys, &c., which form so striking a contrast to the rest of the structure in its present dismantled state. The same building has also furnished a highly picturesque interior, namely, that of its Salle des Gardes, at the end of which is seen a portion of the celebrated winding staircase.

From Fontainebleau, we have the gallery of Francis I., the Court of Honour, a drawing-room, the ball-room, and the pulpit in the church. Among these, the view of the court and its pavilion-gateway, as seen from within the colonnade, has a very pleasing scenic effect, and deserves particular attention, if merely on account of the columns, which are remarkable both for the peculiar mode in which their shafts are ornamented, and for the no less peculiar character of their capitals, composed of foliage, with the heads of sheep boldly projecting at the angles beneath the abacus. The character of these capitals is so spirited and good, in such excellent gusto, that we are astonished they should not have become a standard authority; or that, with such examples ready provided, Louis XIV. should have offered a prize for the invention of a new order.

The *Salle des Fêtes*, or drawing-room of the same palace, is a very beautiful interior of its kind; and though no more of the room is shown than one end of it, and some of the ceiling, that is rather an advantage than not, since it has enabled the artist to do justice to the magnificent and elaborately sculptured chimney, adorned with caryatides larger than the size of life, and forming a picture in itself. It is, indeed, one great merit of the interiors generally, that the view is confined to what can be distinctly seen. The monument of Louis XII. is another fine subject, wherein sculpture predominates; an artist-like portraiture of what is itself a noble work of art. Yet, although it does not possess equal historic interest, we are better pleased, upon the whole, with the next and final plate in the volume, showing a staircase at Blois, in what was formerly a convent; since, notwithstanding there is very little in the subject except a large group of St. George and the Dragon, the arrangement, the execution, and the effect of this drawing are most captivating.

If we have left the majority of the subjects unnoticed, it is because the mere mention of them would be tedious, while it would be hardly possible for us to discriminate their several beauties and merits, even were we to enter into particular description of them. We could only repeat our encomiums in different phrases, and therefore content ourselves with assuring our readers, that if they have any taste for picturesque architecture, they will find much

gratification in these "Sketches." That they will be satisfied, is, however, more than we dare promise them, because it is probable that, like ourselves, they will feel their appetite increased for more of the same fare. Our hope is, that the success of this his first course will induce Mr. Müller to serve up to us a second and third; whether he confine himself to buildings of the very same style and period, or seek for subjects elsewhere, most certainly he would not have to search for them very long, as an untouched store of them are to be met with in edifices, which, though they may have been delineated in their general forms so repeatedly as to be familiar to the eye, can as yet hardly be said to have been illustrated by the pencil at all, with regard to any part of their interiors.

INSTITUTION OF CIVIL ENGINEERS.

Description of the methods adopted for raising and sustaining the sunken Roof of St. George's Church, Dublin. By Robert Mallet, Assoc. Inst. C. E.

St. George's parish church, one of the finest ecclesiastical edifices in the city of Dublin, was completed in the year 1802, from the designs of the late Francis Johnston, Architect to the Board of Works at that time, at a cost of about £90,000.

The church had not been built many years, before the roof, which was covered with tun slating and copper, gradually sunk in several places, by which the cornices at the flank wall were pushed several inches outwards. The subsidence slowly but continually increased. The ceiling cracked in various places, the ornamental stucco work began to drop off, and, in the year 1836, the state of the roof was such, that the church was deemed unsafe for use, and was shut up.

Messrs. John and Robert Mallet were consulted as to the practicability of restoring the roof. In November, 1836, they reported that they considered the ceiling might be preserved, and described the manner in which they proposed to accomplish it.

The mode proposed, consisted in interweaving with, and adapting to, the timber framing of the roof, a system of metallic framing, so arranged, that all strain or stress should be removed from the former, and borne by the latter, as well as removing all lateral pressure from the walls of the building.

A careful survey of the roof showed that the ends of several of the principals were unsound. A small hole was then bored through the ceiling, close to each queen-post, and a deal rod ½ an inch square dropped through each. These rods were all of equal length, and their upper ends were secured level with the top surface of the tye-beam of each principal; then, with a levelling instrument placed in the gallery, observations were taken, and the exact amount of the deflection of the framing ascertained. The variation was considerable, but the greatest amount of depression was found to be 5⅞ inches. The whole roof was strained and distorted, and was so unsafe, that the slightest effort caused vibration throughout.

The causes of this failure appeared to be threefold: a radical want of strength in the framing of the roof; secondly, the employment of unfit tye-beams, which, having been constructed during the Continental war, when timber was scarce and dear, were formed almost wholly of short lengths, averaging not more than 20 feet, lapped and scarfed; thirdly, in the queen-posts having been badly constructed and ill placed.

The stone corbels, which supported the oak cantilevers, being originally cut almost through to receive the wall plate, were nearly all broken in the middle. It was proposed, therefore, to remove the oak cantilevers and stone corbels, and to cut away the timber wall-plate beneath each principal, to level up the wall, placing a suitable cast-iron abutment piece at each end, and to spring from side to side a cast-iron arch, in "double flitches," connected through the spaces of the timber framing by hollow distance pieces, and also by a certain number of equidistant cross-heads, from which should drop down vertical suspending rods, capable of being adjusted in length, and connected with the tye-beam of the principal, so that, being drawn up straight, and the respective parts secured, the weight of the whole roof would be transferred through the framing to the tye-beams; whilst they, being hung from the system of suspension rods of the cast-iron arches, which would thus sustain the whole load, and their abutments being held together by the tye-bars in the chord line, the load would bear vertically upon the walls.

It was then determined to raise the roof and ceiling by forces applied from below; to cut away the rotten ends of the principals, and to re-connect them with the walls by a modification of the cantilever bracket, invented by Mr. Alfred Ainger, and described in the Transactions of the Society of Arts (vol. 42). The whole of the oak cantilevers and stone corbels were to be removed as useless incumbrances.

The total weight of the roof being about 133 tons, each framed principal would sustain about 16½ tons, and each vertical suspending rod about 1½ ton.

Although the weight of material in this roof and ceiling may be considered uniformly distributed, it was impossible to foresee what change might be effected in the framing, by forcing the ceiling and roof up to a level line, or what amount of force might bear upon particular points, from the elasticity of the materials being thus forcibly constrained. It hence became a matter of prudence to provide in all parts a large surplus of strength, bearing in mind that, in any complete system, "the strength of the whole is limited by that of the weakest part, and thus that partial strength becomes total weakness." The dimensions of the scantling were accordingly so calculated that the utmost strain upon it should not exceed 4·5 tons per square inch, considering 9 tons to be the practical limit to which wrought iron might be exposed.

After giving the formulæ for calculating the strains upon the different parts of the roof, with the reasons why the theoretical dimensions were in some instances departed from, the author apologises for entering so much into detail of the construction, quoting, at the same time, the writings of Smeaton and Telford, as abounding in the richest details of theoretic deduction, modified by practical judgment. He then proceeds to describe the means adopted.

Immediately beneath each of the fourteen queen-posts of the roof, an aperture of 30 inches square was cut through the floor of the church, and a pier of brick and cement built up from the arches of the vaults beneath to the level of the floor; on the top of each, a plate of cast-iron was bedded, and upon each plate, a block of oak timber about 4 inches thick.

Fourteen straight whole balks of Memel timber, each 3 feet shorter than the height of the church between the floor and the ceiling, with their extremities cut square and smooth, were placed vertically upon the blocks; upon this level, a platform was laid; across the tops of the vertical balks, pieces of oak scantling were placed; fourteen powerful screw-jacks were then fixed, one beneath each queen-post, and the ceiling cut away for the points to bear directly upon the beams.

During the progress of these operations, the whole of the ceiling and roof framing had been carefully examined. The dust was removed from the joints and open mortices, &c., of the framing, and the cracks in the ceiling were cleared out by passing a fine whip saw through them, so as to permit their closing when the ceiling was raised to a plane surface.

The preparations being completed, the word was given to heave simultaneously upon the screw-jacks; the roof rose slowly and steadily, and, as soon as any one of the small deal standard rods had reached the level plane, the motion of the screw-jack at that spot was stopped. In about two hours, the whole roof, together with the ceiling, was brought up level, without any accident or injury to any portion of the ceiling. The cracks in the latter, as well as the joints and mortices of the framing, were found to be nearly all closed. Some slates were broken, and the copper of the platform, which before was wrinkled and loose, was now found to be drawn tight over the timber sheathing.

The roof being thus supported from beneath, the masonry was cut out round the ends of the principals; the oak cantilevers and corbels of granite, and the rotten ends of the timbers, within a few inches of the inside face of the walls, were also removed.

The cantilever and abutment castings were now applied and bedded with lead and oil putty, on blocks of stone set at the level of the under side of the tye-beams, on footings of brick and cement. The chord bars were next placed, and temporarily adjusted by means of their screw nuts. The arch segments were put up in succession, their centre or key pieces bolted in, and the segments adjusted to them by means of wedges of African oak: the suspending rods were then hung on from the top shackles, and the junction made good with the tye-beams, by means of the lower cross-heads, stirrups, and shackles.

As soon as the whole system of the seven arched frames was complete, and the cantilevers adjusted to the ends of the decayed timbers, standing lengths of pine rods were placed in right lines from centre to centre of each pair of abutment cross bolts, and all the chord bars and suspending rods were brought up by means of their adjustment screws, until the united effort of the whole system had lifted and supported the entire roof and

ceiling from the screw-jacks, on which they had previously rested, so that these latter all became loose.

The whole was now quiet for some days, in order that every part might take its bearing, and that the sufficiency of the structure should be proved before the final removal of the screw-jacks, &c., which remained within about $\frac{1}{4}$th of an inch of the blocks beneath the tye-beams, by which means, in case of accident, the amount of fall would have been limited to that small distance. The entire work, including the repairing the cracks in the ceiling, occupied little more than four months, and has never since required either alteration or repair.

The total amount of the contract for this work was £1362 6*s*. The repair of the injury done to the ceiling only amounted to £33 0*s*. 8*d*., and the damage done to the slating, platform, flooring, &c., did not amount to more than an equal sum.

The total amount of cast and wrought-iron in the structure was 21 tons 10 cwt. 2 qrs. 19 lb.

The communication is illustrated by five elaborate drawings on a large scale, showing the general arrangement and modes of proceeding, and also the details of the construction of the roof, and of the cast and wrought-iron works used in the repairs.

DESCRIPTION OF TWO WROUGHT-IRON ROOFS OVER THE BUILDINGS AT MR. THOMAS CUBITT'S WORKS, THAMES BANK. BY MR. ADAMS.

THIS communication describes in detail the construction, and gives the dimensions of the several parts of two fire-proof roofs of 29 feet span, one of which bears, in addition to the covering, a ceiling of tile arches upon iron girders, the weight of which is equal to 5 tons 4 cwt. upon each truss.

The paper is accompanied by two drawings of the roofs.

DESCRIPTION OF A DOUBLE TELESCOPE THEODOLITE. ARRANGED BY NATHANIEL BEARDMORE, GRAD. INST. C.E.

THE improvement in this theodolite consists in its having a second telescope fixed over the ordinary one, in a reverse position, so that the line of collimation of the two telescopes when properly adjusted should be the same. The principal advantage gained is, that a straight line may be carried out with perfect accuracy, without the tedious and uncertain process of adding 180 degrees to the observed angle and reversing the instrument.

A drawing of the instrument accompanied the communication.

ON SETTING OUT CURVES FOR RAILWAYS. BY R. C. MAY, ASSOC. INST. C.E.

THE method of setting out curves proposed in this communication is founded upon the 32d Prop. of the 3d book of Euclid. It consists in cutting off by a chord a segment of the circle to be described, and then finding any number of points in the curve by means of a reflecting instrument, which is set so as to reflect the angle in that segment.

The instrument which has been adapted by the author for this operation, consists of two plane mirrors, the upper one being fixed vertically upon a disc of brass, and the lower one fastened to an arm which turns upon its centre, and permits the two mirrors to be set at any angle with each other: the arm can be fixed by a clamp screw. In the case surrounding the mirrors are two holes for admitting light, and between them is the sight hole, placed so as to bisect the angle formed by the mirrors. From the underside at the centre of the instrument is suspended a slender wooden rod, with a pointed end, weighted with lead.

Angles are taken with the instrument in the same manner as with the box sextant. To determine any point in the curve, the instrument, when set fast, is placed in such a position that the two given objects coincide in the mirrors, and the weighted rod, being released by withdrawing a bolt, falls directly beneath the centre of the instrument, marking the required point in the curve.

The author presented with this paper a Reflecting Instrument, and field tables of chords and segments to be used in setting out curves by this method.

AN IMPROVED PLANK FRAME, FOR SAWING DEAL PLANKS OF VARIOUS THICKNESS INTO ANY NUMBER OF BOARDS. BY BENJAMIN HICK, M. INST. C.E.

THE principal improvement in this machine is a novel kind of gearing for producing what is usually termed the "taking-up" or "traversing motion" of the plank during the operation of sawing.

A revolving motion is given to two pair of coupled vertical fluted rollers, by means of worms and wheels, which are worked by a ratchet-wheel and catch, from the crank shaft of the machine. When a plank is introduced between the moving rollers and the fixed guides in the centre of the machine, the tendency of the motion is to draw the plank forward at each stroke, with a force exactly corresponding to the degree of resistance opposed by the teeth of the saw. By this means, the necessity of any other support or side roller to the plank, during its progress through the machine, is avoided, and any number of planks of different lengths, depth, and thickness, can be put through the machine after each other, without any alteration or stoppage of the work.

Several minor improvements are introduced in the general arrangement of the machine, particularly in the position of the crank shaft and connecting rod, which latter is placed in the centre of the moveable frame, occupying a space which has not hitherto been made use of in machines for cutting two planks simultaneously; and by carrying the crank shaft upon the framing, instead of having it fixed upon a separate foundation, the construction is simplified as well as rendered less expensive.

The communication was accompanied by a working model of the machine.

AN HISTORICAL ACCOUNT OF WOOD SHEATHING FOR SHIPS. BY J. J. WILKINSON.

THIS communication commences with the earliest history of naval architecture, the different modes of construction, and the precautions taken for the preservation of the vessels from the attacks of marine animals.

A very early instance of extraordinary attention to the preservation of the bottom of a vessel appeared in a galley supposed to have belonged to the Emperor Trajan, A.D. 98 to A.D. 117, which was found in the fifteenth century in the lake Hemorese (or Lago Riccio), in the kingdom of Naples, and was weighed after it had probably remained more than 1300 years under water; it was doubly planked with pine and cypress, coated with pitch, upon which there was a covering of linen, and, over all, a sheathing of lead fastened with nails of brass or copper; the timber was in a perfectly sound state.

In the reign of Henry VIII. large vessels had a coating of loose animal hair attached with pitch, over which a sheathing board of about an inch in thickness was fastened, to keep the hair in its place.

It is believed that the art of sheathing vessels was early practised in China: a mixture of fish oil and lime was applied; it was very adhesive, and became so hard that the worm could not penetrate it.

The opinions of Sir Richard Hawkins, of François Cauche, and of Dampier, on the practice of wood furring, are then given at length, with extracts from their journals.

The sheathing the bottoms of ships with timber, appears to have been disapproved by these early navigators. In 1668, the officers of the fleet, then preparing under Sir Thomas Allen for an expedition against the Algerines, petitioned that their vessels might not be thus encumbered, as they were in consequence always unable to overtake the light-sailing unsheathed vessels of the enemy; the petition was granted, upon the condition that precautions should be taken by cleaning the ships' bottoms very frequently.

In 1670 a patent was granted to Sir Philip Howard and to Major Watson, for the use of milled lead sheathing; it was not, however, introduced without difficulty; nor until an order was issued that "no other than milled lead sheathing should be used on his Majesty's ships." About the year 1700 the lead was acknowledged to have failed, and wood sheathing was again introduced.

Numerous instances are given of the employment of wood as sheathing for ships in celebrated expeditions: the ravages of the worm, the accumulation of barnacles and weeds, are then described; the qualities of the wood employed for sheathing in different countries, both formerly and up to the present time, are examined, and the author, who undertook the investigation of this subject, in consequence of finding how little good information existed in an accessible form, promises the history of metal sheathing in a future communication.

MR. BROOKS'S THEORY OF BAR RIVERS.

AN accurate examination of the state of a bar river will exhibit a great irregularity of its surface at low water; in lieu of the river presenting, at that period, a longitudinal section of a succession of inclined planes, as

becoming more and more gentle, in proportion to their proximity to the ocean, it will be often found that the declination or slope of some of the upper reaches is less than those nearer the ocean; and the fall at low water, in the lower reaches of the river, is always so great, as to produce a striking difference in the vertical rise of tide, even at a short distance from the sea; and, attendant upon this defective state of the section presented by the surface of the river at low water, is a great extension of the duration of the ebb, beyond that of the upward current of the flood tide.

The river being in this irregular state, the process by which the bar is formed may be thus described:—

During the period of the first quarter flood, the current, in lieu of being able to take its natural upward course, as in rivers where no bar exists, is opposed, or effectually checked, by the effluent backwater; the declination of the stream in the lower division of the river presenting a head which insures a strong downward current, long after the tide would have been able to maintain an upward course, provided the backwater had had a free discharge. At this period, the flood tide, by reason of its greater specific gravity, occupies the lower stratum of the tide-way, and, like a wedge, endeavours to force its course up the channel, which it is unable to effect, but merely elevates the lighter affluent water, the lower strata of which, being checked by the opposition of the tidal water, yields to the latter the sand or other materials, which it was capable of holding in suspension, previously to its encountering the conflicting action of the flood-tide; and, where this takes place, the bar is formed.

From the above, we may easily extend the illustration to prove that, while the formation or increase of the bar takes place at this period, or during the first part of the flood-tide, the direct tendency of the whole period of the ebb, when unobstructed by the tidal current, must be to reduce the extent of the bar in all its dimensions.

The same useful effect, in keeping down the bar, must also attend the action of the flood-tide, after it has attained a true run up the channel.

Turning our attention to the state of those rivers, which discharge their waters into tideless seas, or fresh-water lakes, we shall still be able to trace to the same cause the existence of their bars, viz., to the excess of slope which their longitudinal sections present near their embouchures: but, as here, the agency of the tide or counter current does not exist, the deposit which takes place will generally be differently affected from that which forms the bar of a tidal river, which latter does not usually experience that great observable elongation of its course, which takes place in rivers which discharge their waters into tideless seas.

The extension of the course of a tidal river only existing where the latter discharges its waters into a shallow sea, or protected bay, the observations on this subject, by Major Rennell, are so clearly expressed, that I cannot do better than give them in the words of their distinguished author:

"It is a circumstance well known to the generality of readers, that rivers which deposit great quantities of matter do also very often separate into two or more branches, previous to their discharge into the sea; thus forming triangular spaces, which the Greeks very aptly called Deltas, from the resemblance they bore to the form of that letter of their alphabet, and also that these Deltas almost invariably encroach on the sea, beyond the general, and, it may be supposed, the original line of coast. However, the formation of such Deltas, even by rivers of the first magnitude, is by no means universal; on the contrary, some of them terminate in deep inlets or estuaries, instead of projecting forms; or, if the expression be allowed, they terminate negatively, instead of positively; of this class, may be reckoned the great rivers of the Amazons, Plata, and the Orinoco, besides many others, which, perhaps, bring down an equal quantity of the matter of alluvions with the Nile, Ganges, or any other river that may form the projecting Delta. This difference appears to be owing to the original conformation of the adjacent coast, and to the depth of the sea beyond it: if the estuarium into which the river discharges itself, and the sea beyond it, are exceedingly deep, the alluvial matter will be lost in the profundity; whilst, in a shallower sea, not only the bed of the inlet itself will be filled up, but the matter will form a projecting tract beyond it; and here it may be observed, that the increase of Deltas will almost necessarily be slower in modern than in ancient times, since, the farther the work advances, the deeper the space to be filled up must be.

"It is no less certain that, during the progress of forming, by its deposition, the low-land which is to constitute the future Delta, the river, by its overflowings above, also raises such parts of the adjacent countries as are subject to be overflowed by its waters; and hence it must be conceived that such rivers must gradually raise their beds, since, in order to run at all, they must have a continued declivity the whole way to the sea; so that the very act of extending their course by forming new land to the sea, requires a gradual elevation of the ground the whole way, from the margin of the sea upwards: thus alluvial countries must continue to rise by slow degrees, whilst the alluvions encroach on the sea, and the rivers themselves continue to overflow and deposit."

By this natural elongation of the course of rivers by the deposit of alluvial matter, a gradual amelioration of the navigation must take place, inasmuch as that elongation is necessarily attended with a more gradual junction with the waters of the sea, or the diminution of the velocity of the current at the point of discharge; we have, therefore, only to assist the operations of nature, by directing the course of the current, and thereby the position of the deposit of the alluvions, to insure that the latter shall act beneficially, and not prejudicially, to the navigation.

In a tidal river, where a bar exists, and the reduction of the declination of the low water surface cannot be effected, by reason of a long length of rocky bed, too costly to remove, the only means available for its improvement is an artificial elongation of its course, by piers, or other works, to bring the mouth of the river within the influence of a stronger current.

Where the declination of a river is great in its lower reaches, the result of any cut near the embouchure of the river, which is not attended by a simultaneous reduction of that declination, must be the increase of the bar. It is, however, to be observed, that the natural attendant effect of the shortening the course of the current, is the more free discharge of the water and abasement of the level of the surface of the current; and, wherever this latter circumstance does not take place, it is solely due to the presence of some geological feature, such as rock, or marl, which the current, when unassisted by art, is unable to act upon.—*Brooks on Rivers.*

EXPORTATION OF MACHINES.

(*Continued from page* 190.)

"M. Roman, one of the Delegates from the Haut et du Bas Rhin, examined.

Q. "What is the number of cotton manufactures existing in the localities which you represent?

A. "Fifty-six mills, with upwards of eight hundred thousand spindles, giving employment to one hundred and twenty thousand people, of all ages, in the different branches of spinning, weaving, &c.

Q. "Do our workmen continue to improve?

A. "Yes; but they are still far behind the English workmen in point of ability. We have visited England, and we know all their processes; but there is something in the English workmen, a sort of cross between the French and German character—a mixed breed of the Norman and Saxon, which renders them at the same time active and thoughtful.

Q. "What are the advantages which the English manufacturers possess in general?

A. "They possess great advantages in the speciality of their industry; each one manufactures largely, and confines himself to one thing, so that he acquires by this means a great superiority. I have no need to enumerate the advantages which they possess of cheap coal and iron. They have got the start of us; we may follow them, but we shall never be able to pass them by. We know all that they are doing; we have such constant intercourse with them, that they can have no new invention or process which is not immediately known and adopted by us.

Q. "What is the price of coals in Alsace?

A. "The average price is 44*f.*, equal to 36*s.* 6*d.* per ton.

Q. "What is your opinion of the effect of the import duties on iron and machinery?

A. "I believe they have been favourable to France, in encouraging large establishments, of which she was in need. It is indispensably necessary to trade to have establishments capable of furnishing, not only English machinery, but any other which may be wanted.

Q. "So that if you want any machinery, you can procure it at home good, and at a reasonable price?

A. "Yes; at present we order all those machines in France, which a short time ago we ordered in England.

Q. "And the prices; are they the same for English machinery?

A. "They cost us the same—that is, adding to the English prices the import duty, expenses of carriage, &c. In England the mills work more regularly than ours do; they are all moved by steam power. Our mills in Alsace are moved by water power, which occasions many stoppages at certain seasons of the year; but this inconvenience will soon cease, as we are adding steam engines as auxiliaries to our water wheels.

Q. "You know that the Chamber of Commerce of Tarrare has petitioned for the free importation of cotton yarns, for all numbers under 160, on paying an import duty of 17*d.* per lb. What objection do you make to this proposition?

A. "I am convinced that raising the prohibition would be a mortal blow to our trade, and that it would be a premium to encourage English industry.

"M. Robert Belin, delegated by the Bobbin-net Lace Makers of St. Quentin, examined.

Q. "You represent the bobbin-net lace manufacturers at St. Quentin. What information have you to give to the Committee respecting this branch of trade?

A. "I can inform you of its origin and its actual state. Amongst the trades which have been represented before this inquest, no one ought more to excite the attention of Government, because no one has so much need of protection. Its present situation is extremely bad. Within a few years, the material employed in it has suffered a depreciation of 75 per cent., while the produce of that material has fallen 40 per cent. within the last six months.

Q. "At what epoch dates the establishment of this trade in France?

A. "Our firm imported the first machinery in 1821; there existed at that time several at Calais and at Douay. There are at present upwards of 1500 looms in France. We employ English cotton yarns from Nos. 170 to 220, which is smuggled in from England. The whole consumption of these yarns is about 190 tons annually. We prefer English cotton yarns, though we pay 10 per cent. dearer for them.

Q. "The house of Heathcot is established at St. Quentin, upon the English model; how does it happen that it manufactures at 25 per cent. dearer in France than in England?

A. "On account of the general expenses, which are higher in France than in England.

Q. "What is the annual amount of bobbin-net lace consumed in France?

A. "I estimate it at one million sterling.

Q. "Of which, as it appears, two-thirds are smuggled in from England.

"M. Ernest Feray, Cotton Spinner at Essonne, examined.

Q. "Have the goodness to inform the Commission what is the present state of your manufactory compared with similar establishments in England.

A. "The quality of our yarns is much improved of late years. Our Nos. 40 to 70 warp is quite as good as the English. We have also improved as regards the economy of production, and the improvements would have been much more important if they could have been supported by low-priced coals and machinery. The English possess these advantages in the highest degree, which the evidence of M. Mimerel clearly and truly explains.

Q. "At present, do you possess all the improved machinery which you require?

A. "Yes; but it must be borne in mind that our neighbours never remain stationary. Every year sees some improvement, which we are obliged to obtain and adopt, however expensive it may be. *I do not ask for the free importation of machinery from England, because I know it would prove the ruin of our machine-makers, who, like our spinners and manufacturers, have to struggle with the high price of combustible and iron.* On my last journey to Manchester, I learned enough to prove that the prices of labour are about on a par in the two countries; and that, if the Manchester spinner earns more than ours do, it is because he does a much greater quantity of work.

"M. Pihet, Machine Maker at Paris, examined.

Q. "You are a machine maker; have the goodness to inform the Council of the nature of your establishments as regards the construction of machines used in the cotton and woollen manufactures, and what improvements have taken place?

A. "We make all kinds of machinery, but more especially machines used in the above branches. Both spinning and preparing machines have been much improved of late years. As regards the prices of them, compared with the English prices, the difference is not very great. Previous to 1830, we exported the half of the machines we constructed. Our principal outlets were Belgium, Prussia, Russia, Spain. At present, there are establishments for machine-making in Belgium, and our exports are not so great. Our home trade is increasing; we have never had so many orders on hand as at this moment. The value of our constructions at four different periods is, viz.:—

	Francs.
"1822, value of one year's construction .	39,816
"1826, " " .	559,715
"1830, " " .	898,483
"1833, " " .	2,526,663

Q. "Are these machines intended for new mills?

A. "There are very few new mills. These machines are intended for rechanges, or additions, or to replace old ones."

This is conclusive evidence. It establishes these important facts, namely, that though foreign manufacturers possess machinery as good as ours, and are in possession of all our newest processes and latest inventions, yet they are unable to compete with us in their own markets, without the protection of prohibitory duties. They declare unanimously, that the manufactures of France would be annihilated if English manufactures were allowed to be imported with a duty of 30 per cent.; that nothing short of absolute prohibition, and the most stringent application of the laws for the abolition of smuggling, would be a sufficient protection against the low prices at which goods are produced in England, where manufacturers are favoured infinitely above those of other nations in all the conditions of cheap production. With respect to neutral markets, foreign manufacturers are able to compete with us in a very limited number of articles, in which they happen to be favoured by some peculiar circumstances, arising from speciality of trade, or the established taste for some peculiar kinds of goods.

Such were the arguments used by the French manufacturers in defence of the prohibitory system, which a few enlightened but timid economists were desirous of replacing, by a scale of duties in themselves scarcely less prohibitive. But the mass of evidence brought forward on the inquiry, respecting our advancement in manufactures, our commanding capital, extensive markets, the speciality and division of our labour, the superiority of English artisans, the cheapness of coals, iron, lighting, machinery, and repairs, was so great and so convincing, that, instead of liberalizing the laws, it was decided that it would be prudent to render them, if possible, more restrictive and severe. With such incontrovertible facts before our eyes, and the knowledge and experience we have gained by our travels and intercourse with other nations, I confess I cannot understand the fears of our manufacturers, or the scruples of our legislators.

(*To be continued.*)

IMPORTANT INVENTION IN MACHINERY.

Our attention has been called, by an article in one of the provincial newspapers, to a very important mechanical invention, for which a patent has recently been granted to two Scotch gentlemen, and which promises to effect a greater and more beneficial change in the working of machinery, than has taken place since the brilliant discoveries of Watt. The two great drawbacks of the steam-engine (besides the large space it occupies) have been the bulk, and the consequent expense, of the fuel which it requires, the latter preventing its application to many purposes for which it would otherwise have been a most effective agent; and the former impeding its locomotive energy, and confining it, particularly as regards navigation, within comparatively narrow limits. Any reduction in either of these respects is thereby obviously so much clear gain. The invention to which we allude promises to effect a prodigious saving in both, by diminishing the expenditure of fuel to somewhat less than one-fifth of what is now required for an equal degree of power. It has already, we are informed, been put to the test by the construction of an engine of about 20-horse power, which has for some time been driving all the machinery of an extensive foundery with no larger consumption than we have just mentioned, and with every prospect of a considerably greater reduction being effected by some slight changes in the details. The motive power used is the common atmospheric air; and another great advantage of the new engine arises from a saving of space, equal to what is usually occupied by the furnace and boilers of a steam engine.

If these things be so, it is impossible to calculate the results to which so important a discovery must lead. But we hasten to present our readers with the following description of the engine, which we have abridged from the newspaper already referred to.

DESCRIPTION.

The air-engine now working at the Dundee Foundery, for which a patent was lately taken out, is the joint invention of the Rev. Dr. Stirling, of Galston, and of his brother, Mr. Stirling, engineer, Dundee.

The principle of the invention consists in alternately heating and cooling

two bodies of air confined in two separate vessels, which are so arranged that, by the strokes of two plungers, worked by the engine, the whole of the air contained in one of the vessels is sent to the lower end immediately over the furnace, and is consequently made quite hot, while the whole of the air contained in the other vessel is at the same time transmitted to the upper end, which is cut off from any communication with the furnace, and is therefore comparatively cold.

The expansion caused by the heat renders the air in the one vessel alternately much more elastic than that in the other; and the two ends of the working cylinder, which is fitted with a piston similar to that of a steam engine, being respectively connected with the two air vessels, a preponderating pressure is produced, by turns, on each side of the piston, which is thereby pushed to the opposite end of the cylinder; and so, by the alternate action of the plungers in the two air vessels, it continues a reciprocating motion, and is applied to turn a crank in the same way that a steam engine does.

It has been satisfactorily shown that this engine may be worked with very great economy of fuel as compared with a steam engine. The principal means of producing the saving is this—that, of the heat which is communicated to the air from the furnaces, only a very small portion is entirely thrown away when it comes again to be cooled; for, by making the air, in its way from the hot to the cold end of the air-vessel, to pass through a chamber divided into a number of small apertures or passages, the great extent of surface with which it is thereby brought in contact, extracts from it in the first place, bnt only temporarily, the greater part of the heat; and afterwards restores it to the air on its passage back again from the cold to the hot end of the vessel. The process of cooling is finally completed, by making the air pass through between a number of tubes in which there is a current of cold water, and thus far the heat cannot be made available again, but the portion which is abstracted in this way is very small.

As a sufficient expansive power could not be attained in so small a space without greater alternations of temperature from using air of the common density of the atmosphere, the air used is pretty highly compressed, and a much greater power is thereby obtained upon a given area of the piston.

A small air-pump, worked by the engine, is therefore necessary to keep up the air to the requisite density; but very little power is expended on this; all that is required of the pump, after the engine has been once charged, being to supply any loss of air that may arise from leakage, which is found to be very trifling.

The machine has been working occasionally for above six months, and it has been proved to be capable of performing advantageously the amount of work which the inventors had anticipated from their calculations and previous experiments. It has now for upwards of a month been driving all the machinery at the extensive engineering works of the Dundee foundery, which a steam engine of approved construction had hitherto been employed to do; and it has been ascertained that the expenditure of fuel is, *cæteris paribus*, less than one-fifth part of what was required for the steam engine; but, as considerable improvements are contemplated in some of the details, it is confidently expected that a much greater saving will eventually be effected.

The whole machine, including its furnaces and heating apparatus, stands in about the same space that a steam engine of equal power would occupy without its furnaces and boiler. Taking into account the saving of space along with the vast economy of fuel, this invention must necessarily be of immense importance for all ordinary purposes requiring motive power. As an instance, it would reduce the expense of the power employed in driving machinery in Dundee alone by at least £25,000 or £30,000 a year. But, viewed in reference to the purposes of navigation, it must lead to results still more extraordinary, and will render a voyage to India round the Cape by machinery a matter of perfectly easy accomplishment.—*Morning Chronicle.*

CAPTAIN TAYLER'S BREAKWATER.

On Wednesday last an opportunity was afforded us of examining a model of the new wooden breakwater invented by Captain Tayler. It was about two feet long, and represented a perfect prism. Through the centre runs a very strong beam or keel; smaller beams cross and recross this in an almost endless series, secured by bolts at both ends. These connect it with the beams which form the sides of the prism, and those again at the ends which form the angles are secured by means of transverse pieces of timber. No correct idea, however, can be formed of the strength and beautiful architecture which this model conveys to the mind of the invention, without the assistance of a series of diagrams: we shall not therefore attempt a laboured description, but proceed to mention the manner in which it is proposed to be employed for the security of harbours, and the method of mooring it. The breakwater may be of any length, but it is divided into sections of 60 feet. The timber employed is red pine, so arranged that three-fourths of the breakwater will be immersed. It will be always 18 feet below the level of the immersion, and 6 feet out of the water. As the present iron mooring chains, if of requisite strength, would not only increase the weight but the expense of the breakwater, without adding anything to its usefulness, the difficulty is overcome by forming them of straight-grained timber—it being admitted that this material will bear a much greater strain than an equal weight of iron. The timber employed for this purpose is red fir, larch, or American ash, in lengths of twelve feet. Three of these form a section of the mooring. The centre piece is 9 inches deep and 4½ inches thick, and those on either side 9 inches deep and 2½ inches thick, making the whole 9 inches square. These are bound together with flat iron hoops put on red-hot, in order that the contraction of the metal, when cold, shall more firmly embrace and clasp together the three members of the section. At each end of the centre-piece are three saw-cuts, about 2 feet long, and into the centre cut an oak wedge is driven, which spreads the timbers about 4 inches, thus forming a dovetail. Before driving these wedges in, the iron hoops, as well as the staples for connecting them with other sections of the mooring, must be put on and made tight by the wedges. The specific gravity of these moorings, exclusive of the connecting links, we were informed, will not exceed by 20 per cent. that of the water. The breakwater will be moored obliquely to the waves, and will admit the sea to pass under, over, and through it, thus breaking and dispersing the waves, and converting all within its barrier into smooth water. The inefficiency of stone breaks for the purposes intended was noticed in *The Times* a few weeks back, and consequently a mere allusion to the fact will be sufficient; but we do not think that any notice was taken of the circumstance that air more than water is the enemy of stone breakwaters. This was proved some time since at Plymouth, where the stones were dovetailed, and a hole having been made by a breach in the wall, the air was driven with such force into the cavity, that it actually forced out one of the stones from the very centre of the work! The consequence was, that the Admiral, fearing a repetition of the accident which happened some time ago—namely, a direct rupture of the breakwater, no longer sanctions the dove-tailing. It is stated that upwards of 15,000 English vessels, 3,150 American and French, 1,000 Danes and Swedes, 1,000 Prussian, Norwegian, Dutch, and Russian, and 500 Spanish, Portuguese, and other vessels, pass the Mount's Bay annually, amounting in the aggregate to 20,650 vessels, and with the average crew of 10 men to each vessel, the entire number of seamen will be 206,500. The annual loss of lives and the value of the ships and merchandise destroyed is immense; and to prevent this, it is said, a breakwater in the harbour of Penzance, costing only 52,400*l.*, would suffice. Under such circumstances, and supposing the calculations correct, and the invention all it is represented to be, it would appear that at no distant date such a desideratum will be supplied.—*Times.*

MISCELLANEOUS.

Removal of Sunderland Light-House.—The removal of this lighthouse from the north pier in an entire state to the eastern extremity of the pier, a distance of nearly 500 feet, was safely and successfully completed on Thursday the 30th September, under the able management of Mr. Murray, the civil engineer. The following is the plan submitted by Mr. Murray to the commissioners of the River Wear in May last, when it was under their consideration to pull down and re-erect the lighthouse on its new site:—"The masonry was to be cut through near its foundation, and whole timbers were to be inserted, one after another, through the building, and extending seven feet beyond it. Above, and at right-angles to them, another tier of timbers was to be inserted in like manner, so as to make the cradle or base a square of 20 feet; and this cradle was to be supported upon bearers, with about 250 wheels of six inches diameter, and was to traverse on six lines of railway to be laid on the new pier for that purpose. The shaft of the lighthouse was to be tied together with bands, and its eight sides supported with timber braces from the cradle upwards to the cornice. The cradle was to be drawn and pushed forward by powerful screws along the railway above-mentioned, on the principle of Morton's patent "slip for the repairing of vessels." The project was approved of, and the necessary arrangements made for carrying it into effect; the only deviation from its plan being, that, during the progress on the work, a windlass and ropes, worked by 30 men, was substituted for

the screws. Not a crack nor appearance of settlement is to be found if the building, which has now only to be firmly established on its new foundation.

The Metropolitan Wood Paving Company have just completed about 4 or 5,000 yards of pavement in Regent Street, by direction of the Commissioners of Woods and Forests. This is one of the results of the good success of the specimen at Whitehall, and the Company seem determined to repay the confidence of the Government by increased exertions. The pavement is laid upon the Company's metallic sand concrete, and the grooves in the wood are cut much deeper than has hitherto been practised. It is much to be regretted that measures are not immediately taken to form one continued line of wood paving, from Regent-street to Oxford-street, so as to test the wood pavement fairly, instead of its being, as now, covered with mud from the adjoining stones and macadamized parts. The success of the Metropolitan Company has already brought them an accession of business, and we understand that they are likely to have another contract in Holborn. They have also laid down a piece of wood pavement around St. George's church, in the Borough.

Encroachments of the Sea at Dover.—The base of Bullock-rock, on which is built Archcliff-fort, we perceive has been undermined to a very great extent by the washing of the sea, and, as there are several large clefts in various parts of it, there is every reason to fear that a portion of it will soon give way. The platform leading to the entrance of the tunnel under Shakespeare Cliff, which was many feet in width, has also disappeared, with the exception of a narrow slip; but, as a second tunnel is yet to be excavated, we do not apprehend that it will be of any loss to the South Eastern Railway Company. One thing, however, is now quite certain—the Company will not be able to make the railroad in this place stand, without going to the expense of erecting a wall to defend it from the encroachments of the sea; and this, it appears to us, would be advisable before the Dover terminus of the tunnel be commenced, if the materials for the construction of the same can be obtained. The whole of the beach, as we before observed, having been carried away, nothing now remains to prevent the sea washing against that vast and stupendous cliff which Shakespeare has immortalized, and we perceive that, even here, also, the raging surf seems fully bent upon destruction. A large quantity of several thousand tons' weight fell into the sea on Sunday last, near the mouth of the railway tunnel, and many other huge masses may be seen at a distance, tottering over an excavated base. A walk, therefore, beneath this cliff may now be considered as extremely dangerous.—*Times.*

Invention to aid Vessels in distress.—A plan has been laid before the Academy of Sciences, by M. Longchamp, to render succour to vessels in distress, however violent the weather. His machine he calls Nautile de Sauvetage, and is thus described:—"The Nautile de Sauvetage is composed of a chest of zinc, recovered with internal arches of wood, of which the perpendicular section is elliptical, and terminated at the bottom with a sort of appendix. Its length is 3½ metres, and its cubic content about 1,600 litres. Its top is covered in all its length with a saddle, having as many pair of stirrups as the nautile is intended to carry men, in such a manner that they sit upon this nautile as men on horseback.

"Six men are placed on the nautile, of which three manage the wheels with palettes in wood or cloth, which have their resistance, not in the water but in the air. This means of propelling boats has already been put in practice on the Seine, in 1785, with complete success.

"Behind the nautile is attached a cord which is veered from the boat, and when the men have reached the shore, they draw, by means of this cord, a cable which they fasten on the shore, and thus enable those on the vessel to reach it."

The inventor says, let the wind and weather be what it will, the ship can be reached by the nautile, and should the machine be turned by the violence of the wind or waves on its side, it will, from its construction, soon right itself, and as the men it carries are, as it were, nailed to the saddle, all that they will experience will be a momentary ducking.

LIST OF PATENTS,

Continued from page 216.

(SIX MONTHS FOR ENROLMENT.)

Jean Louis Alphonse Petigars, of Brewer Street, Golden Square, gent., for "improvements in the construction of presses," being a communication.—Sealed September 24.

Hugh Lee Pattinson, of Bensham Grove, Durham, manufacturing chemist, for "improvements in the manufacture of white lead, part of which improvements are applicable to the manufacture of magnesia and its salts."—Sealed September 24.

Frederick Brown, of Luton, Bedford, ironmonger, for "improvements in stoves or fire-places."—Sealed September 24.

Theodore Frederick Strong, of Goswell Road, engineer, for "certain improvements in locks and latches."—Sealed September 28.

Samuel Stocker, of Barford Street, Islington, engineer, and George Stocker, of Birmingham, cock founder, for "improvements in machinery and apparatus for raising, forcing, conveying, and drawing off liquids."—Sealed September 28.

John While, of Burton in the Wolds, Leicester, farmer, for "an improved horse-hoe for use in agricultural pursuits."—Sealed September 29.

Joseph Miller, of Monastery Cottage, East India Road, engineer, for "an improved arrangement and combination of certain parts of steam engines used for steam navigation."—Sealed September 29.

Edward Welch, of Liverpool, architect, for "certain improvements in the construction of bricks."—Sealed September 30.

William Hirst, and Joseph Weight, of Leeds, clothiers, for "certain improvements in the machinery for manufacturing woollen cloth, and cloth made from wool and other materials."—Sealed October 7.

Thomas Wells Ingram, of Birmingham, manufacturer, for "improvements in shears and other apparatus for cutting, cropping, and shearing certain substances, part of which said invention being a communication from a foreigner residing abroad."—Sealed October 7.

Joseph Clisild Daniel, of Tiverton Mills, Bath, for "improvements in the manufacture of manure, or a composition to be used on land as a manure."—Sealed October 7.

Mathias Nicolas La Roche Barre, of Saint Martin's Lane, Middlesex, manufacturer of cotton, for "an improvement in the manufacture of a fabric applicable to sails and other purposes."—Sealed October 7.

Marcus Davis, of New Bond Street, optician, for "improvements in the means of ascertaining the distances vehicles travel."—Sealed October 7.

Thomas Biggs, of Leicester, merchant, for "improvements in securing hats, caps, and bonnets, from being lost by the effect of wind or other causes."—Sealed October 7.

Benjamin Aingworth, of Birmingham, gent., for "improvements in the manufacture of buttons."—Sealed October 7.

John Jones, of Smethwick, Birmingham, engineer, for "certain improvements in steam-engines, and in the modes or methods of obtaining power from the use of steam."—Sealed October 7.

John Harwood, of Great Portland Street, gent., for "an improved means of giving expansion to the chest."—Sealed October 7.

William Newton, of Chancery Lane, civil engineer, for "certain improvements in engines to be worked by gas, vapour, or steam," being a communication.—Sealed October 14.

Moses Poole, of Lincoln's Inn, gent., for "improvements in fire-arms," being a communication.—Sealed October 14.

Edward Massey, of King Street, Clerkenwell, watchmaker, for "improvements in watches."—Sealed October 14.

Henry Ross, of Leicester, worsted manufacturer, for "improvements in combing and drawing wool, and certain descriptions of hair."—Sealed October 15.

Junius Smith, of Fen Court, Fenchurch Street, gent., for "improvements in machinery for manufacturing cloths of wool, and other fibrous substances," being a communication.—Sealed October 20.

John Bradford Furnival, of Street Ashton, farmer, for "improvements in evaporating fluids applicable to the manufacture of salt, and to other purposes where evaporation of fluids is required."—Sealed October 20.

Henry Davies, of Birmingham, engineer, for "certain improved tools or apparatus for cutting or shaping metals and other substances."—Sealed October 21.

Thomas Jones, of Varteg Forge, near Pontypool, Monmouth, engineer, for "improvements in the construction and arrangement of certain parts of marine and stationary steam-engines."—Sealed October 21.

James Whitworth, of Bury, Lancaster, manufacturer, and Hugh Booth, of the same place, machine maker, for "certain improvements in looms for weaving."—Sealed October 21.

Martyn John Roberts, of Brynycaeran, Carmarthen, gent., and William Brown, of Glasgow, merchant, for "improvements in the process of dyeing various matters, whether the raw material of wool, silk, flax, hemp, cotton, or other similar fibrous substances, or the same substances in any stage of manufacture, and in the preparation of pigments or painters' colours." Sealed October 26.

Thomas Holcroft, of Nassau Street, Middlesex, gent., for "an improved portable safety-boat, or pontoon."—Sealed October 28.